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Fishing Lake Spring Spawning Assessments 2001 - 2003

Resource Technical Report 2007-1

By:
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January 2007

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FISHING LAKE SPRING SPAWNING ASSESSMEMTS, 2001 – 2003

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EXECUTIVE SUMMARY

Fishing Lake is a relatively large, saline waterbody located in the southeastern part of the province near the Town of Wadena. The lake consists of two distinct basins, which are joined during periods of high water. The large, eastern basin has been heavily developed with numerous cottage subdivisions and two Regional Parks adjacent to its shoreline. The smaller and shallower western basin has remained largely undeveloped in terms of recreational facilities; much of its shoreline borders Fishing Lake Indian Reserve # 89.

Several tributaries provide freshwater inflows into the lake during spring run-off events. Hazel Lake, a small lake to the southeast of Fishing Lake, lies on a height of land. In spring, Hazel Lake fills and flows into Fishing Lake, and in some years concurrently spills eastward into Usinneskaw Lake. In most years, Fishing Lake has no outflow. However, as occurred in 1997, when Fishing Lake reaches an elevation of 529.74 m, it spills eastward into Hazel Lake, through a series of lakes and sloughs to ultimately reach the Whitesand River and Assiniboine River system. Prior to 1997, SaskWater estimated that 69 years passed prior to the last simulated outflow in 1929.

Van Pattens Creek, flowing from the north into the west basin, has been documented in previous surveys as being an important stream for pike reproduction. Receding spring water levels however frequently resulted in the stranding of many adult pike. In 1985, a spawning marsh was developed to enhance pike reproduction in Van Pattens Creek 6.5 km upstream from its confluence with Fishing Lake. Since 1985, an extended spring closure to angling has been in effect to protect spawning pike. Following consultation with Fishing Lake First Nations, this closure was expanded in 1998 to include all types of fishing.

Despite the presence of suitable spawning areas, successful reproduction of pike within the lake itself appears to be limited and is likely affected by water quality. An intensive survey of gamefish populations in 2000, a year when there was no spring run-off, failed to capture any young-of-the-year pike. Maintenance of the walleye populations has been dependent on regular fry stocking since 1923.

Utilization of the fish populations is largely recreational, with anglers targeting pike and walleye. First Nations peoples from nearby reserves take advantage of the spawning runs of pike on several tributaries into Fishing Lake. Van Pattens Creek has been a traditional fishing area. Limited gillnetting is also carried out on the west basin of Fishing Lake for subsistence fishing.

Three tributaries were assessed to determine their importance as fish spawning areas in 2001 and 2003, when adequate run-off provided suitable study conditions. Fish counting fences with traps, pound traps, hoop nets, fry traps and small mesh sweep nets were used to capture adult fish moving up the creeks and subsequently to capture fry and fingerlings moving back towards Fishing Lake. Ultrasonic transmitters were implanted in ten adult pike in 2001 to monitor their movements within the lake.

Pike, walleye and white sucker were captured migrating up the tributaries to spawn. The capture of adult walleye moving up the Hazel Creek system and the capture of juveniles in downstream gear indicates that walleye successfully reproduce in areas that traditionally were thought to be pike spawning grounds.

Higher flows in 2003 as compared to 2001 likely contributed to greater numbers of fish moving up the streams in 2003. Almost 4000 adult pike and 500 adult walleye moved up from Fishing Lake into Hazel Creek in 2003, over double the numbers documented in 2001. Extrapolations from pike fingerlings moving downstream indicate that approximately 15 500 young-of-the-year pike returned to Fishing Lake in 2003 from the Hazel Creek system.

Based on results obtained from tracking ten adult fish, pike tend to return to the same spawning areas in subsequent years: five of the fish that were tagged near the inlet of Hazel Creek were located in the same area in spring of 2002, despite the lack of any spring run-off. The fish also successfully move between the two lake basins, providing water levels are adequate.

An earlier assessment on the fish resources of Fishing Lake indicated that the recreational fishery harvested large amounts of gamefish, based on an angler survey carried out in 2000. Results suggested that the fish resources were not sustainable if the current pressure from the recreational fishery continued. Amounts taken by the subsistence fishery were unknown. During 2001 and 2003, members of the three local First Nations Reserves provided information on the numbers and species of fish utilized. When the domestic harvest of 2494 gamefish is compared to the harvest of 46 500 pike and walleye taken by anglers, it is apparent that the domestic fishery takes only a small proportion of the total gamefish harvest. Sport fish limits have subsequently been reduced with the designation of Fishing Lake as a Catch and Release Type 1 waterbody.

Recommendations based on the study findings include protection of the riparian areas adjacent to the creeks to ensure conditions remain suitable for fish reproduction. Further work was identified to evaluate the importance of Hazel Lake for pike and walleye reproduction, particularly in anticipation of a control structure which would reduce spring flows from Hazel Lake to Fishing Lakes during years when water levels are high. Some follow-up work was carried out during 2004, and results are attached as Appendix 1.

Since the amount of fish harvested by the subsistence fishery was minimal, there does not appear to be a valid conservation reason for keeping the extended closure on Van Pattens Creek, and lifting the closure should be considered.

Acknowledgements

I would like to thank Gord Burrows, Al Young, Magel Sutherland, Tom Maher, Doug Robinson and the many other individuals from Saskatchewan Environment who enthusiastically carried out the fieldwork. The assistance of the field officers from Wadena, Scott Harvey and Dale Achtymichuk was greatly appreciated. Local landowner Borden Woloshyn provided expert suggestions in the operation of the pike spawning marsh on Van Pattens Creek and donated much of his time and equipment. Department of Fisheries and Oceans provided staff time, equipment and expertise. Bruce Howard and Richard Orr were collaborators in the field design of the study, as well as provided many helpful comments on the manuscript. Co-workers Mark Duffy and Murray Koob reviewed the report and made editorial suggestions. And finally, thank you to Brent Desjarlais, who carried out a major portion of the fieldwork and served as a liaison between the government departments and the local band members. The cooperation of the First Nations in the area in volunteering information on their use of the fish resources is greatly appreciated. Members of the Fishing Lake Co-Management Committee were involved in the project from its inception, and provided much insight and advice:

- Department of Fisheries and Oceans
- Ducks Unlimited
- Fishing Lake First Nations
- Fishing Lake Watershed Association
- Kinistin First Nations
- Rural Municipality of Sasman
- Saskatchewan Environment
- Saskatchewan Watershed Authority
- Yellowquill First Nations

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1. INTRODUCTION

Fishing Lake, located approximately 25 km southeast of the Town of Wadena, is a popular destination for water-based recreation including boating, swimming and angling. The lake is comprised of two distinct basins (Fig. 1). The larger east basin has been developed along its northeast shore with several cottage subdivisions, and two Regional Parks are situated at the south end. No cottage developments exist around the smaller west basin. A large portion of this basin is located adjacent to Fishing Lake Indian Reserve # 89. A Baptist Camp is situated at its north end.

During times of high water, the two basins are joined and boat travel between the two is possible. Since the mid 1990s water levels have been high, and in spring 1997 Fishing Lake reached its highest level since 1964, when water levels were first recorded for this lake. These extreme conditions resulted in the flooding of many cottage subdivisions, campgrounds and other facilities such as ball diamonds, boat launches and docks.

Pike, perch and white sucker were originally present in Fishing Lake, as documented by Saskatchewan Environment historical files, dated 1923, and are still present today. In order to diversify angling, area residents at that time requested that walleye be stocked. Fishing Lake has been stocked with walleye fry since 1923, and pike were stocked as eyed eggs and fry during the 1950s and 1960s. High pH and total dissolved solids likely limit reproduction of walleye. Since 1977, the gamefish populations have been surveyed routinely every four to five years by Saskatchewan Environment (SE). An earlier study, carried out in 1960 (Royer 1961), provides some baseline information on the morphometry and limnology of the lake as well as the biology of the fish, plankton and benthos.

Utilization of the fish resources is mainly through the sport fishery, although some limited netting occurs through a domestic fishery. Angling is a popular activity at Fishing Lake, with anglers targeting walleye and pike. First Nations utilize the spring spawning run of pike on Van Pattens Creek, a major tributary flowing into the north end of the west basin. In the 1960 investigation of Fishing Lake (Royer 1961), it was documented that large numbers of pike ascended the northern tributaries to spawn, and many fish were unable to return to the lake due to dropping water levels. The greatest fish losses were recorded in Van Pattens Creek.

In 1984, a spawning marsh to enhance pike reproduction was constructed approximately 6.5 km upstream of Fishing Lake on Van Pattens Creek. The project was a joint effort between Saskatchewan Environment and the Kuroki Branch of the Saskatchewan Wildlife Federation (SWF), with funding from Fish and Wildlife Development Fund. A control structure, consisting of two culverts with stop logs, was installed to allow management of water levels. From 1985 until 2002, a total of 422 550 pike fingerlings have been harvested from the marsh. The majority of these fingerlings have been stocked into Fishing Lake.

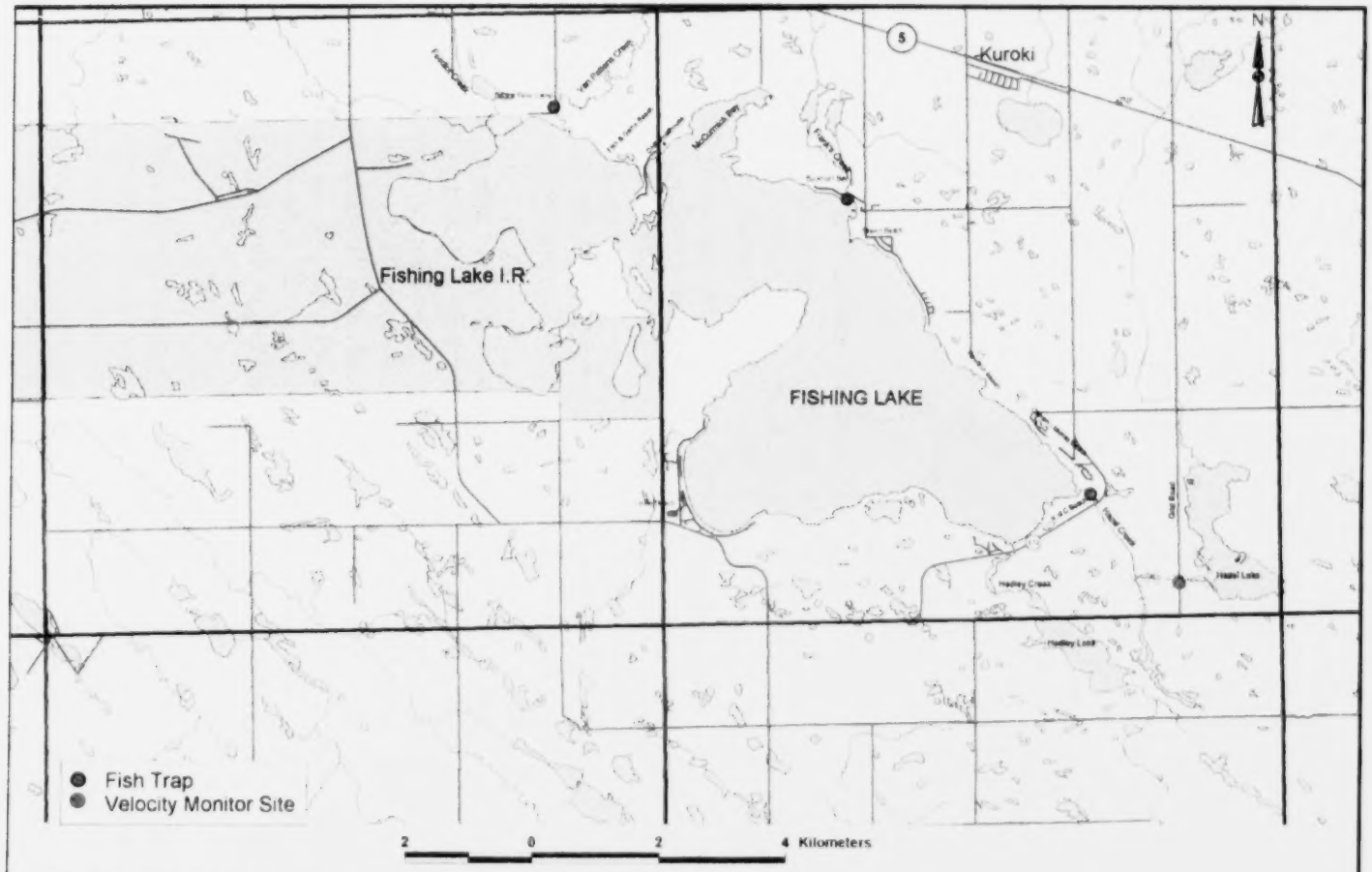

Fig. 1 Fishing Lake and immediate area, showing fish trap and velocity monitoring locations.

In order to protect the pike spawning in Van Pattens Creek, an extended spring sportfishing closure has been in effect since 1985. After consultation with the Fishing Lake First Nation, the closure was extended in 1998 to restrict all types of fishing from April 1 to the Friday immediately preceding Victoria Day.

1.1 DESCRIPTION OF THE DRAINAGE BASIN

Fishing Lake has a total surface area of approximately 3000 ha. When water levels drop below approximately 528 m, the two lake basins become separate, restricting boat traffic and also fish movements between the lakes (SaskWater 1997). Fishing Lake is subject to wide fluctuations in water levels, which in turn affect water quality parameters such as salinity, pH and dissolved oxygen. During 1951-52, water levels were extremely low and a fish die-off was reported in the small lake (Royer 1961). Since the mid 1990s, high water levels have prevailed and the two basins have been joined.

The major drainage area of Fishing Lake is from the north: Van Pattens Creek, flowing into the north end of the west bay, drains 212 km^2 of the total 653 km^2 gross drainage basin to Fishing Lakes (SaskWater 1997). Water flowing into Fishing Lake is mainly from spring run-off or precipitation. In most years, Fishing Lake has no outflow. In the spring, Hazel Lake, located southeast of Fishing Lake, fills and drains into the lake. In some years, Hazel Lake also spills eastward into Usinneskaw (Stoney) Lake. When Fishing Lake reaches elevations over 529.74 m (full supply level), as occurred in 1997, it spills eastward into Hazel Lake and through a series of sloughs and small lakes, eventually reaching the Whitesand River and the Assiniboine River system. Hydrologic modeling has predicted that 69 years have elapsed between the 1997 outflow and the last simulated outflow in 1929 (SaskWater 1997).

The high water conditions experienced during the mid to late 1990s prompted the formation of the Fishing Lake Watershed Association. Several proposals have been brought forward from the association for review in an effort to control water flows into Fishing Lake and reduce the potential for further flooding. The most recent proposal involves installation of a control structure on the creek flowing between Hazel Lake and Fishing Lake.

1.1.1 Project Scope

Concerns over fish populations, unquantified harvest levels from all fisheries and potential impacts anticipated with construction of a control structure have resulted in several years of investigative work pertaining to the fish populations, including:

- Assessment of the fish resources in 2000, utilizing quarter-standard gang gillnets, downhaul trap net and the electro-fishing boat. Young-of-the-year gamefish and forage fish were assessed using seine and dip nets.
- Determination of sport fishery pressure and harvest by carrying out a creel census during the open-water season in 2000.

Results from these investigations are written up in a separate report (Merkowsky 2005). It was identified that further investigation was required pertaining to the importance of the tributaries for spawning.

The objectives of the present survey included:

- Assessment of spawning runs on several tributaries to Fishing Lake to determine their importance for pike reproduction.
- Evaluation of the production of pike fingerlings from the spawning marsh located on Van Pattens Creek.
- Evaluation of the contribution of the stocking program to the walleye population in Fishing Lake
- Assessment of the importance of Hazel Lake to fish production.
- Quantification of harvest taken by the domestic fishery on tributaries to Fishing Lake.
- Recommendations regarding management changes necessary to ensure the resources are maintained in a healthy state

2. METHODS

2.1 PHYSICAL AND CHEMICAL PARAMETERS

Limited monitoring was carried out to assess water quality, and included temperature, pH, conductivity and flow velocity. Temperature was automatically recorded hourly by a Stowaway Tidbit temperature logger; pH and conductivity were measured with an Accumet Portable AP50 pH/Ion/Conductivity Meter; and flow was taken using a Global Flow Probe Digital Water Velocity Meter. Water quality monitoring was done on Hazel Creek, Hazel Lake and Van Pattens Creek.

A temperature-oxygen profile was taken at two stations in Hazel Lake in July 2003. Oxygen concentrations were measured just prior to sunrise, using an YSI Model 85 Handheld Oxygen, Conductivity, Salinity and Temperature System.

2.2 DETERMINATION OF STUDY SITES

In early spring, 2001, staff from Saskatchewan Environment inspected several tributaries to Fishing Lake to identify sites where spawning assessments could be carried out. Five potential sites were examined: Van Pattens Creek and the smaller tributary west (locally known as Feedlot Creek), both flowing into the west basin, and Franks Creek (Buckhorn Bay), Hazel Creek and Hedley Creek, all flowing into the east basin (Fig. 1). Based on historic data, local knowledge, and accessibility, Hazel Creek, Van Pattens Creek and Franks Creek were chosen for assessment. Hedley Creek was rejected for study, as it did not appear that the culvert under the roadway would provide fish passage due to its elevation. Feedlot Creek was not accessible during early spring but some follow-up work was carried out to assess its importance for pike reproduction.

Spring spawning investigations were conducted over two years (2001 and 2003) when adequate run-off provided suitable study conditions. In 2002, there was little run-off so work in this year concentrated on open-water investigations.

2.3 INTERCEPTION OF SPAWNING RUNS

In Hazel Creek and Van Pattens Creek, counting fences equipped with traps were used to effectively block off the complete channel. Installation took place as early in April as ice conditions allowed during both the survey years.

The traps consisted of a plywood base with metal conduit installed through bars to form the sides. Figure 2 illustrates the counting fence and trap used on Hazel Creek. The trap used at Van Pattens Creek was similar in design although it was slightly larger. Wings, consisting of conduit threaded through two guiding bars, attached to the front sides of the trap and extended to the bank. The trap door could be lowered to keep fish in the trap while it was being checked. Each trap was covered with a plywood top that was locked in place to prevent unauthorized tampering with the fish. Several large signs were posted, informing the public that the trap was a scientific research site and unauthorized access was not permitted.

In both creeks, the trap was installed as close to Fishing Lake as possible in order to capture all fish ascending these tributaries. In Hazel Creek, the trap was erected downstream of the culvert on Highway 310 at the site of an old road crossing during both years of survey (Fig. 1). At Van Pattens Creek, the trap was installed at the Baptist Bible Camp site in 2001. In 2003, the installation of the fish trap began at a site downstream of the 2001 location, below the large beaver dam. However, difficulties in the installation were experienced due to high water flows, an accumulation of ice on the creek bed and floating blocks of ice . As the trap was being installed, large numbers of pike were observed ascending the creek. The following day the trap was moved downstream to a site just up from the creek mouth. Flows and water depths were so great that the west shore fence was installed using a boat. During the evening, the trap was dislodged: tampering and/or ice blocks took out the west wing and lifted the trap. It was again reset, although it was not possible to block the entire channel due to the large amount of debris and ice coming downstream. The trap was taken out and moved to a location just down stream of the first grid road crossing (Fig. 1). It was also reversed in an attempt to capture pike on the return to the lake following spawning activity. No quantification of total numbers of fish moving up Van Pattens Creek was made in 2003.

At Franks Creek in Buckhorn Bay, a single culvert allows water from a relatively large marshy area upstream to flow into Fishing Lake. Inspection during 2001

Fig. 2 Illustration of fish counting fence and trap used at Hazel Creek in 2001 and 2003.

revealed that the culvert had collapsed, preventing fish from leaving the lake and moving into the upper areas of the creek. No further work was carried out in 2001. The culvert was replaced, and in 2003 a pound trap was installed on the downstream side of the culvert to capture fish as they returned to Fishing Lake.

In all three tributaries, the traps were monitored once or twice daily. The fish were removed from the traps with long-handled dipnets, identified to species, measured as to fork length, sexed when possible and then released on the opposite side of the trap.

Gill nets were set in Hazel Lake in 2001 and 2003 to determine if adult fish successfully accessed the lake.

2.3.1 Assessment of Reproductive Success

Flooded grasses and weeds within Fishing Lake and its flooded marshes and tributaries were sampled with a small-mesh dip net at several locations for various periods of time to collect eggs and larval pike:

- Hazel Lake at its outlet and on Hazel Creek upstream of Highway 310 crossing
- Feedlot Creek at 3-34-12 W2
- Marshes adjacent to Fishing Lake at 13-33-12 W2 on reserve lands and at N1/2 12-33-12 W2 west of Leslie Beach
- Van Pattens Creek at NE 36-33-12 W2 at the grid road (three-culvert crossing) south of Highway 5.

A variety of gear, including fry traps, hoop nets and seine nets, were used in Hazel Creek from May to early July, 2003 to assess reproductive success. Fry traps consisted of rectangular small mesh nets that were set in the main creek flow in approximately half the depth of the water column. The nets were set and left for a 24 hr period. Fry trapping was carried out on several locations on Hazel Creek on May 21 and 22, and again on June 9 and 10, 2003 (Fig. 3).

In addition to the fry traps, hoop nets were set downstream of the culverts on the grid road crossing and the Highway 310 road crossing of Hazel Creek. The nets were set directly off the culverts to effectively block the entire flow and capture any fish moving downstream to Fishing Lake. The nets were set once a week, left for a 24 hr period and then checked and removed.

Seining was also carried out at various sites in Hazel Lake and creek to determine whether reproduction was successfully occurring (Fig. 3).

Fingerlings produced in the pike spawning marsh on Van Pattens Creek were trapped and enumerated from June 5-8, 2003. A hoop net was installed immediately downstream from one of the culverts draining the marsh. The hoop

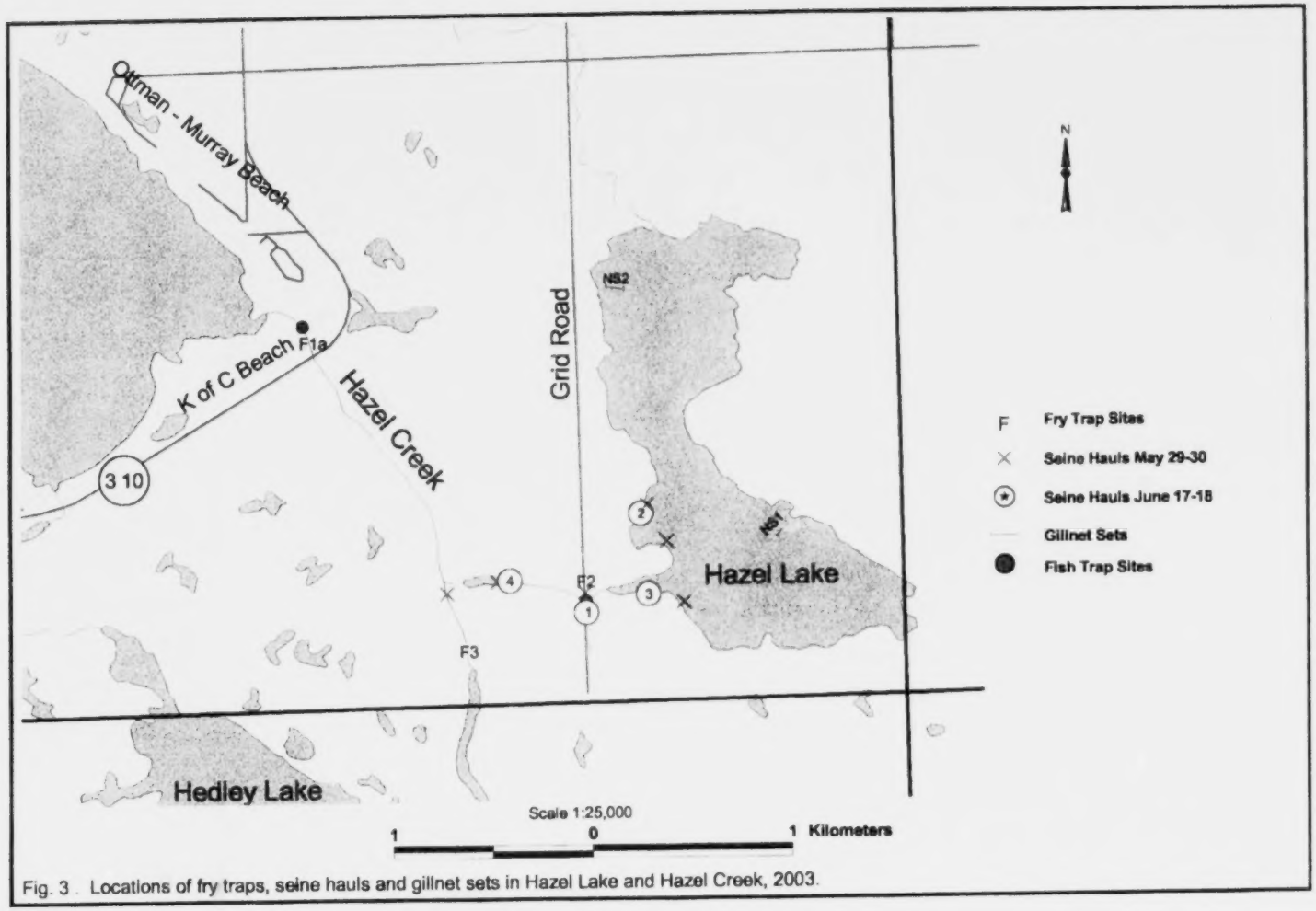

Fig. 3 . Locations of fry traps, seine hauls and gillnet sets in Hazel Lake and Hazel Creek, 2003.

emptied into a box fry trap. The nets were monitored 24 hrs per day until draining was completed, a period of four days. Fingerlings were dipnetted out of the fry trap and transported and stocked into Fishing Lake in distribution tanks fitted either with an oxygen diffuser or an agitator. Sub-samples of fingerlings were hand counted and directly weighed to determine an average weight of fingerling. The remaining fingerlings were enumerated by weighing the fish in a pre-weighed amount of water and dividing by the average weight per fingerling.

Return of adult fish to Fishing Lake was assessed by reversing the counting fence on Hazel Creek during 2003 once fish began congregating on the upstream side of the trap. Prior to turning the trap around, a salvage operation was carried out by seining in the channel between the fish trap and the culvert on Highway 310 and releasing those fish downstream of the trap. During the dates that the fry traps and hoop nets were set to capture juvenile pike, the door to the fish trap in the counting fence was closed for 24 hr to sub-sample numbers of adults returning downstream. During time periods when monitoring was not done, the door was left open and conduit was removed from the back of the trap to permit fish to freely pass through.

2.4 PIKE TRACKING

Ultrasonic transmitters were surgically implanted into ten adult pike in spring of 2001 to track their movements throughout the lake. Fish were not retained for implant during spawning interceptions, as it was felt that the extra handling would be too stressful.

On May 23, 2001, a six-foot square downhaul trap with a 150 ft lead was set near the inflow from Hazel Lake in the east basin. Concurrently a 20 m gillnet of small mesh was set in the west basin off Van Pattens Creek, and it was checked frequently for fish. Angling for pike in the west basin was also undertaken by SE staff. Efforts to capture the fish in both basins concentrated on areas near the tributaries under study in order to capture fish that had utilized Hazel Creek or Van Pattens Creek for spawning.

The downhaul trap was successful in capturing over a dozen large pike (> 70 cm fork length) in the overnight set. Two pike were collected by anglers from the west basin. Both of these fish were fin-clipped for identification purposes. Small mesh gill-net sampling did not produce any pike. All fish were put into a distribution tank fitted with oxygen and transported to shore, although transmitters were implanted in just ten pike.

Transmitter implantation was performed at Knights of Columbus Beach. MS 222 was added to a cooler of measured water (0.004% concentration) to anesthetize the fish. The fish were only lightly anesthetized: as soon as they exhibited lack of movement they were removed from the cooler and placed upside down on a foam support for surgery. All surgical instruments were disinfected in a Betadine solution, and the incision site was also swabbed with the antiseptic. An incision

of approximately 4-5 cm in length was made in front of the vent and slightly to one side. Irrigation of the gills of the fish was carried out by pumping lake water out of a fish tub. Additional anesthetic was given, if necessary, by placing the pump in the cooler and irrigating with water containing the MS 222 for a brief period of time. The ultrasonic transmitter was placed into the body cavity through the incision. The incision was sutured, and Vetbond applied to seal it. An injection of a general antibiotic was then given to help prevent infection.

An external orange dart tag was inserted beneath the dorsal fin to identify the fish. Signs were posted in the local SE Field Office, sporting good stores in Wadena and at access points to Fishing Lake to inform anglers about the tagging program. Anglers were asked to release any tagged fish they caught, but if unreleasable, they were requested to return the transmitter to the local SE office.

Eight tagged pike captured in the trap net in the east basin were released at Knights of Columbus Beach, relatively close to the area of capture. The two pike caught by angling in the west basin were tagged and returned to their point of capture, using a boat and distribution tank.

Tracking the tagged fish began in June, 2001 and continued every few weeks throughout the open water season by boating the perimeter of the lake and then following a grid pattern. The tracking system consisted of a USR-96 manual-tracking receiver, used with a directional hydrophone and a pair of headphones. Unfortunately interference caused by waves, plant material and likely, other suspended particles resulted in a limited transmission range of 50-100 m, making tracking difficult.

Tracking continued throughout the months of ice cover, utilizing an 8-inch ice auger to drill holes to insert the hydrophone. Transmitter range in deep water extended up to 800 m, whereas closer to shore it was reduced to about 500 m. As spring approached, tracking was carried out more frequently through the ice until break-up. The transmitters had an 18-month life span so tracking was discontinued after spring 2002.

2.5 QUANTIFICATION OF THE DOMESTIC FISHERY

Subsistence fishing has occurred in Fishing Lake for many years, as documented by historical files dating back to 1921 (Saskatchewan Environment). Under several Supreme Court of Canada decisions, subsistence fishing for food takes priority over all other fisheries, unless conservation of fish stocks is an issue. Treaty rights allow members of First Nations to obtain fish using a variety of methods including angling, snaring, dipnetting and gillnetting.

Attempts were made in both 2001 and 2003 to determine amounts of fish harvested by the domestic fishery. During both years, members from the nearby First Nations Reserves were observed dipnetting and snaring pike as the fish moved upstream to spawn on both Van Pattens and Hazel Creeks. According to

locals (B. Desjarlais, pers. comm.) some limited netting occurs for walleye in spring when members from Fishing Lake First Nation set gillnets through cracks in the ice on Fishing Lake.

In 2001, Brent Desjarlais from Fishing Lake First Nation was hired by Saskatchewan Environment to assist with fisheries assessments on Fishing Lake, to serve as a liaison between the Department and the adjacent bands, and to provide and obtain information, traditional knowledge and utilization of the fishery resource by First Nations. Mr. Desjarlais was instrumental in contacting the three local bands and providing them with information on the fisheries study. He developed a reporting structure so that any harvest by First Nations was recorded. In 2003, with the exception of one individual, all numbers and species of fish taken by the domestic fishery was quantified and written up in a brief report.

3. RESULTS

3.1 PHYSICAL AND CHEMICAL PARAMETERS

Water quality parameters for Hazel Creek and Van Pattens Creek during 2001 are given in Table 1, and in Tables 2 and 3 for 2003. In 2001, water quality was monitored only at the Highway 310 culvert, whereas in 2003 it was measured at the 310 culvert and at the grid road culvert located just below Hazel Lake. Figure 1 indicates locations of the stations where water quality was monitored.

pH of Hazel Creek varied from 8.49 to 8.88 in 2001. In 2003, pH varied from 7.27 to 8.32 at the Highway 310 culvert and 6.51 (questionable reading) to 8.66 at the grid road crossing. In general, pH tended to be lower in 2003 than in 2001, likely due to greater spring flows in 2003.

Conductivity in Hazel Creek varied from 1420 µS/cm to 1640 µS/cm in 2001. Conductivity was lower in 2003, ranging from 635 – 1150 µS/cm at Highway 310 and 554 – 1180 µS/cm at the grid road crossing in 2003. Higher spring flows in 2003 likely resulted in increased amounts of fresh water flowing down the creek.

In 2001, velocities were measured at Hazel Creek only at the Highway 310 culvert. Flows varied from 0.09 to 0.60 m/sec in 2001. Much higher flows were experienced in 2003: flows ranged from 0.19 to 1.39 m/sec at Highway 310 culvert at its outlet, and from 0.80 to 2.85 m/sec at the outlet of the culvert on the grid road crossing. Although the latter reading appears high, the flows were rechecked several hours later with similar results.

At Van Pattens Creek, pH ranged from 7.30 to 7.77 in 2001. In 2003, pH values varied from 6.90 to 7.81. Conductivity in 2001 ranged from 1300 to 1580 µS/cm. Values were substantially lower in 2003, varying from 270 to 891 µS/cm.

Table 1. Summary of fish trap catches in Hazel Creek and Van Pattens Creek in 2001.

A. **Hazel Lake Inflow** – Trap installed on April 16, 2001 and checked daily.

Date	Pike	Walleye	White sucker	Temp range, °C	pH	Cond, µS/cm	Flow* m/sec	Notes
April 20	18	0	1	2.1 – 9.6	8.69	1460		
April 21	262	0	0	0.7 – 6.5	8.84	1590		2 pike dead on shore
April 22	468	0	5	3.7 – 9.2	8.88	1640	0.12	4 treaty fishers
April 23	331	0	0	6.1 – 10.6				
April 24	39	0	0	7.1 – 12.1				
April 25	33	0	0	9.3 – 13.3	8.49	1500	0.22	
April 26	0	0	0	8.5 – 14.7	8.69	1470	0.03	
April 27	31	1	0	9.0 – 15.4	8.80	1420	0.40	
April 28	76	4	0	11.3 – 18.4				
April 29	91	34	3	13.2 – 16.6				
April 30	4	0	0	10.4 – 15.1				
May 1	0	3	1	10.1 – 12.4				
May 2	0	1	0	7.5 – 12.6				
May 7	0	2	6					Trap pulled
TOTAL	1353	45	16					

*Flow measured at culvert outlet

B. **Van Pattens Creek** – Trap installed on April 21, 2001 through ice, and checked daily.

Date	Pike	Walleye	White sucker	Temp range, °C	pH	Cond, µS/cm	Flow* m/sec	Notes
April 22	19	0	0	3.6 – 6.9	7.58	1580	0.01	
April 23	44	0	0	2.8 – 10.3				
April 24	157	0	0	4.5 – 11.7				30 Treaty fishers took 60 pike
April 25	81	0	1	4.2 – 11.0	7.30	1550	0.05	
April 26	86	0	0	3.8 – 10.7	7.54	1550	0.06	
April 27	80	0	0	6.4 – 13.7	7.77	1300	0.07	20 Fish taken by Treaty Fishers
April28	16	0	0	8.8 – 15.9				
April 29	22	0	1	11.4 – 13.7				
April 30	25	0	0	9.0 – 13.8				
May 1	1	0	0	9.3 – 11.5				Door closed to trap
May 2	2	0	0	7.6 – 11.4				
May 3	0	0	0					
TOTAL	533	0	2					

*Flows were measured slightly upstream of the trap.

Table 2. Hazel Creek water quality results, 2003.

	Highway 310 Culvert						Grid Road Culvert						
Date	Time	Temp °C	pH	Conductivity µS/cm	Velocity Inlet	M/sec Outlet	Time	Temp °C	pH	Conductivity µS/cm	Velocity Outlet*	M/sec Inlet	Comments
April 9					0.50	0.40							
April 10						0.19							
April 11	915	2.8	7.27	894	0.50	0.40							
April 12	1000	4.8	7.50	708	0.65	0.50					0.80	1.00	
April 13					1.14	0.90		3.1	7.35	705	1.13	1.38	Culvert submerged
April 14	1115	4.4	7.60	770	1.26	1.19		3.8	7.50	605	2.00	1.70	NP & CWS backed up
April 15	1125	3.8	7.50	738	1.20	1.25	1700	4.3	8.00	673		1.19	
April 16	1000	1.3	7.60	695	0.69	0.69		1.1	7.80	688	1.19	1.03	CWS passing
April 17	1330	2.8	7.98	680	0.79	0.72		2.4	7.70	660	1.07	1.00	
April 18		5.2	7.78	654	1.29	1.39					1.71	1.21	Water 36 cm over culvert
April 19	1030	7.5	7.62	582	1.27	1.25	935	4.4	7.66	587	1.73	1.59	NP & CWS trying to move up
April 20		9.2	7.80		2.00	1.20					2.85*	1.17	Lots of fish going through culvert
April 21	830	8.0	7.66	616	2.74	1.16	830				1.55	1.28	Water still overtopping culvert
April 22	945	9.7	8.05	585	1.10	1.10	1010	7.8	8.10	554	1.58	1.40	
April 23		10.3	8.10	590	1.20	1.21		7.8	8.12	586	1.66	1.46	
April 24	850	9.8	8.03	635	1.72	1.21		7.8	7.85	685	1.61	1.46	
April 25	930	8.6	7.83	690	1.22	1.20		8.2	7.83	770	1.40		Water still 10-15 cm over culvert
April 26	930	8.8	7.97	772		0.90	1020	8.5	8.04	866	1.35		
April 27	930	5.5	7.95	850		0.95	1030	6.8	6.51	960	1.40		Snowed
April 28	930	6.9	8.14	928		1.00	1035	7.7	8.14	1000	1.20		
April 29	925	7.3	8.27	996		0.95		8.4	8.39	918	1.16		
April 30	930	8.8	8.32	938		0.87		9.5	8.48	991	0.98		
May 1	945	9.2	8.32	1020		0.80	1025	9.3	8.51	996	1.15		
May 2	900	11.3	8.16	1030		0.80	1000	11.7	8.66	1020	1.10		
May 3	1045	15.6	8.40	1050		0.92	1145	13.2	8.90	1010	1.10		
May 4	945	12.1	8.02	1060		0.84		12.1	8.40	1010	1.00		
May 5	1000	13.2	7.92	1060		0.77	1050	13.6	8.45	1020	0.82		Water still 6 cm over culvert
May 6	930	12.7	8.11	1060		0.75	1115	13.4	8.47	1080	0.99		
May 7	930	11.2	7.97	1170		0.76		12.0	8.11	1100	0.86		
May 8	940	11.9		1120		0.74		12.6		1120	0.87		
May 9		12.4		1150		0.78		12.6		1180	0.77		

Outlet velocities recorded were generally measured at 0.6 of the total depth. NP is northern pike; CWS refers to white sucker.

* Although 2.85 m/sec appears high, the flow was measured twice during different times of the day with similar results.

Table 3. Van Pattens Creek water quality results, 2003. Water quality characteristics were measured at center culvert.

Date	Time	Temp °C	pH	Conductivity µS/cm	Velocity m/sec East culvert Inlet	East culvert Outlet	Center culvert Inlet	Center culvert Outlet	West culvert Inlet	West culvert Outlet	
April 10	1800	3.3	7.59	356			0.42	1.12		0.9	Culvert submerged
April 11	1015				1.04	1.65					
April 12	1700	6.2	7.50	270			1.10	1.04			Fish on downstream side
April 13	900	3.9	6.90	335			0.95	0.84			Pike jumped downstream of culvert
April 14	1000	4.5	7.30	364	0.80	0.67	0.72	0.72	0.74	0.72	
April 15	1545	5.6	7.80	402	0.57	0.50	0.57	0.82	0.55	0.70	Velocity readings questionable
April 16	1200	1.6	7.70	438							
April 17											
April 18	1200	5.6	7.66	460	0.28	0.26	0.30	0.26	0.32	0.26	
April 19	1500	11.7	7.57	482			0.27	0.28			
April 20	1130	11.2	7.55	495			0.23	0.22			
April 21	1030	10.6	7.50	523			0.20	0.19			
April 22	1100	11.4	7.54	552	0.30	0.30	0.35	0.40	0.35	0.27	
April 23	1200	12.2	7.55	593			0.10	0.10			
April 24	1030	11.3	7.50	626			0.09	0.09			
April 25	945	10.3	7.61	622							No longer any flows
April 26	1140	10.3	7.75	675							
April 27	1115	7.4	7.70	675							
April 28	1115	7.5	7.78	719							
April 29	1130	7.5	7.78	713							
April 30	1150	9.8	7.81	734							
May 1	1050	9.2	7.74	757							
May 2	1045	11.4	7.62	782							
May 3		14.3	7.70	797							
May 4	1130	12.7	7.60	790							
May 5	1115	14.0	7.62	825							
May 6	1150	13.8	7.66	857							
May 7	900	13.3		874							
May 8		12.6		891							

Velocity measurements were only taken at the center culvert (of three equal diameter culverts) on the grid road crossing Van Pattens Creek in 2001, and varied from 0.05 to 0.10 m/sec. Much higher flows were experienced in 2003, and measurements were taken from the east and west culverts occasionally as well as from the center culvert. Flows ranged from <0.10 to 1.65 m/sec.

Limnological measurements taken in the center of each basin in Hazel Lake on July 4, 2003 at the one-meter depth are given below:

	North Basin	South basin
Water Temperature, °C	18.2	18.3
Dissolved Oxygen, mg/L	6.22	0.44
pH		8.07
Conductivity, µS/cm	1110	1132
Salinity, mg/L	600	700

Because minimum oxygen levels are typically recorded just prior to sunrise, the limnology examination was done between 4:30 and 5:30 am. The south basin of Hazel Lake was almost void of oxygen. Previous measurements taken through the ice on March 15, 2002 revealed an oxygen concentration of 1.5 mg/L at 1.5 m.

3.2 CHARACTERISTICS OF THE SPAWNING RUNS

3.2.1 Hazel Creek

In 2001, the counting fence and metal trap was installed in Hazel Creek on April 16. At the time of installation, ice and snow blocked the mouth of the creek. On April 20, although minimum water temperature was just 2°C, the first fish were noted in the trap. Between April 20 and April 30, a total of 1354 northern pike were captured in the trap. Other species included 45 walleye caught between April 27 and May 7, and 16 white sucker. Results are given in Table 1. Despite dropping air temperatures during the survey period in 2001, (water temperatures as low as 0.7°C), the pike run continued, peaking on April 22 at 468 pike. Numbers of pike were highest from April 21 to April 23, and declined after that date. Maximum water temperature on April 23 was over 10°C.

In 2003, the trap was installed at the same site on Hazel Creek on April 9. The first pike was captured on April 10. Water temperatures on April 10 varied between 2.9°C and 7.0°C. Water temperatures in 2003 tended to be warmer than in 2001 (Tables 1 and 2). Between April 10 and May 7, a total of 3794 pike were captured (Table 4). Additionally, a total of 448 walleye were caught between April 16 and May 5, and 1402 sucker.

Figures 4 and 5 depict numbers of fish captured each day in the counting fence trap against daily minimum and maximum water temperatures for Hazel Creek, 2001 and 2003. From the graphs, it is apparent that daily minimum water temperatures were consistently higher in 2003, with the exception of a drop on April 16-17 to temperatures approaching 0°C.

Table 4 Numbers and species of fish captured in Hazel Lake fish trap in 2003.

Trap installed on April 9, 2003
Turned around on May 7, 2003.

Date	Number of			
	Pike	Sucker	Walleye	Temp Range, °C
April 10				2.9 - 7.0
April 11	1	0		1.6 - 6.6
April 12	548	24		3.7 - 7.8
April 13	261	34		3.7- 5.8
April 14	332	167		2.9 - 5.8
April 15	224	33		2.9 - 4.6
April 16	99	8	1	0.7 - 2.9
April 17	332	20		0.3 - 4.6
April 18	497	60		2.9 - 8.6
April 19	428	150		6.2 – 11.0
April 20	414	131	2	7.4 - 11.8
April 21	269	112	7	7.8 - 12.2
April 22	171	125	29	8.2 - 12.6
April 23	68	86	34	9.4 - 12.2
April 24	75	65	73	9.0 – 11.0
April 25	27	50	46	7.8 - 12.6
April 26	11	1	35	8.2 - 10.2
April 27	8	50	27	5.0 - 8.6
April 28	8	35	32	5.8 - 10.2
April 29	4	42	47	6.6 - 11.8
April 30	5	55	37	7.8 - 12.2
May 1	1	39	22	8.2 - 12.9
May 2	1	100	12	10.2 - 14.1
May 3	6	2	14	11.0 - 15.6
May 4	2	1	11	11.8 - 15.6
May 5	1	11	19	12.2 - 16.0
May 6	0	1	0	11.8 - 14.9
May 7	1	0	0	11.4 - 13.3
Total	**3794**	**1402**	**448**	

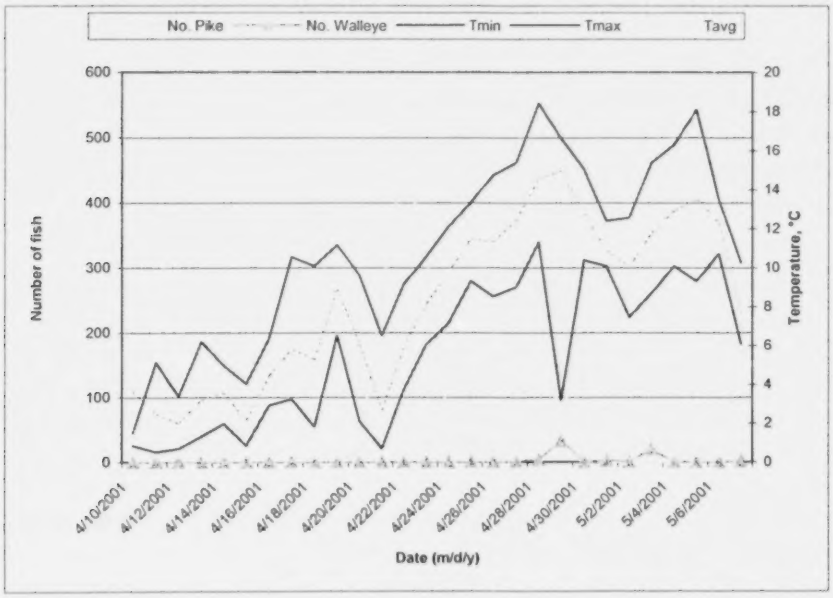

Fig. 4 Numbers of pike and walleye ascending Hazel Creek in 2001. Minimum, maximum and average water temperatures are indicated.

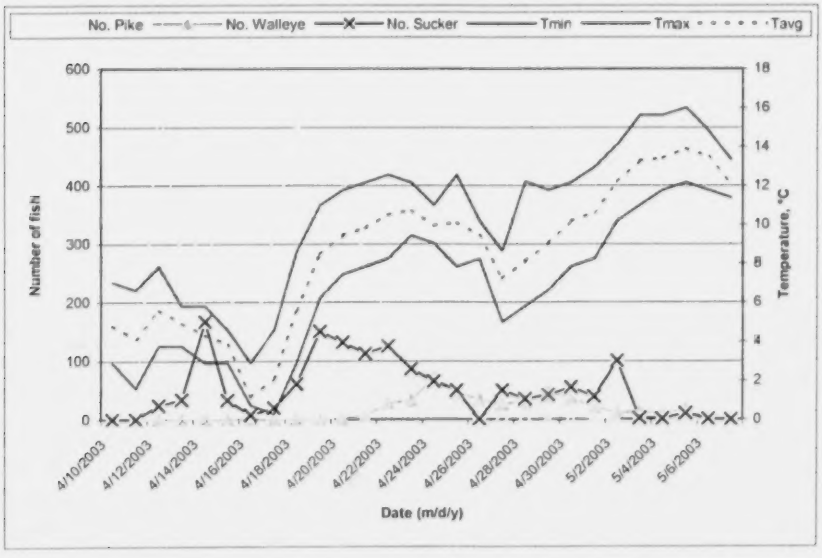

Fig. 5 Numbers of pike, walleye and white sucker ascending Hazel Creek in 2003. Minimum, maximum and average water temperatures are indicated.

With this cooler weather, numbers of pike ascending the creek declined, as did flow velocities. After this date, numbers of spawning pike again increased.

Tables 5 and 6 indicate the sex ratio and sizes of pike for both years. Female pike were consistently larger than the males (Fig. 6). Average fork length of female pike in 2001 was 58.7 cm while the average fork length of the male was 53.6 cm. Larger pike of both sexes appeared to ascend the tributary earlier. Minimum and maximum sizes of pike captured in Hazel Creek for both years of study is given:

	Minimum FL, cm	Maximum FL, cm
2001	44.0	105.0
2003	38.5	115.0

Although males initially ascended the tributary in 2001, by April 24, females predominated the run. Sex ratio was estimated to be 1.1 : 1 in favor of the males. The trap was removed on May 7, 2001.

In 2001, the first ripe female pike was observed on April 21, and numbers of females ready to spawn increased rapidly after that date:

Date (2001)	No. Examined	No. Ripe	% Ripe
Apr 21	110	11	10.0
22	166	24	14.5
23	137	31	22.6
24	24	11	45.8
25	24	18	75.0
26	0	0	0
27	17	16	94.1
28	65	65	100.0
29	85	85	100.0
30	4	4	100.0

Very few fish in spent condition were observed in 2001.

Unlike 2001 when the majority of the pike run occurred over a three-day period, the run in 2003 remained strong for over a week. As in 2001, males ascended the creek first (Tables 5 and 6). However, males outnumbered females significantly throughout the 2003 spawning season, and overall the sex ratio was 1.6 : 1 in favour of males. In both years, larger females ascended Hazel Creek first followed by females smaller in size. Average fork length of female was 62.3 cm, whereas the average fork length of male pike was 56.6 cm.

Table 5. Sex and average lengths of pike in Hazel Creek, April-May, 2001.

Date	Male Pike		Female Pike		Ratio M:F
2001	No.	AvFL,cm	No.	AvFL,cm	
April 20	11	64.3	7	76.3	1.6 : 1
April 21	146	52.4	110	57.9	1.3 : 1
April 22	294	53.7	166	60.2	1.8 : 1
April 23	192	54.6	137	59.8	1.4 : 1
April 24	15	52.2	24	60.6	0.6 : 1
April 25	8	51.5	24	56.9	0.3 : 1
April 26	0		0		
April 27	13	52.6	17	56.7	0.8 : 1
April 28	12	51.1	65	56.7	0.2 : 1
April 29	6	52.8	85	57.6	0.1 : 1
April 30	0		4	56.8	
May 1	0		0	56.6	
May 2	0		0		
Total	697	53.6	639	58.7	1.1 : 1

Table 6. Sex and average lengths of pike in Hazel Creek, April-May, 2003.

Date	Male Pike		Female Pike		Ratio M:F
2003	No.	AvFL,cm	No.	AvFL,cm	
April 12	450	56.8	79	75.4	5.7 : 1
April 13	206	57.4	42	67.2	4.9 : 1
April 14	231	56.7	91	65.9	2.5 : 1
April 15	135	57.1	76	63.4	1.8 : 1
April 16	49	56.1	50	61.9	1.0 : 1
April 17	207	56.1	114	59.8	1.8 : 1
April 18	288	56.1	194	60.2	1.5 : 1
April 19	219	56.8	205	61.7	1.1 : 1
April 20	174	56.5	228	61.3	0.8 : 1
April 21	119	55.9	166	61.1	0.7 : 1
April 22	93	55.9	72	59.1	1.3 : 1
April 23	29	57.1	37	60.0	0.8 : 1
April 24	46	56.4	28	58.9	1.6 : 1
April 25	13	58.5	11	59.2	1.6 : 1
April 26	7	58.2	3	58.9	2.3 : 1
April 27	7	53.3	1	57.5	7.0 : 1
April 28	5	58.4	3	78.0	1.7 : 1
April 29	3	58.2	1	57.5	3.0 : 1
April 30	2	56.3	2	64.0	1.0 : 1
May 1	1	61.5	0		
May 2	0		1	71.0	
May 3	2	57.0	0		
May 4	1	56.5	0		
May 5	0		1	55.5	
May 6	0		0		
May 7	1	46.0	0		
Total	2288	56.6	1405	62.3	1.6 : 1

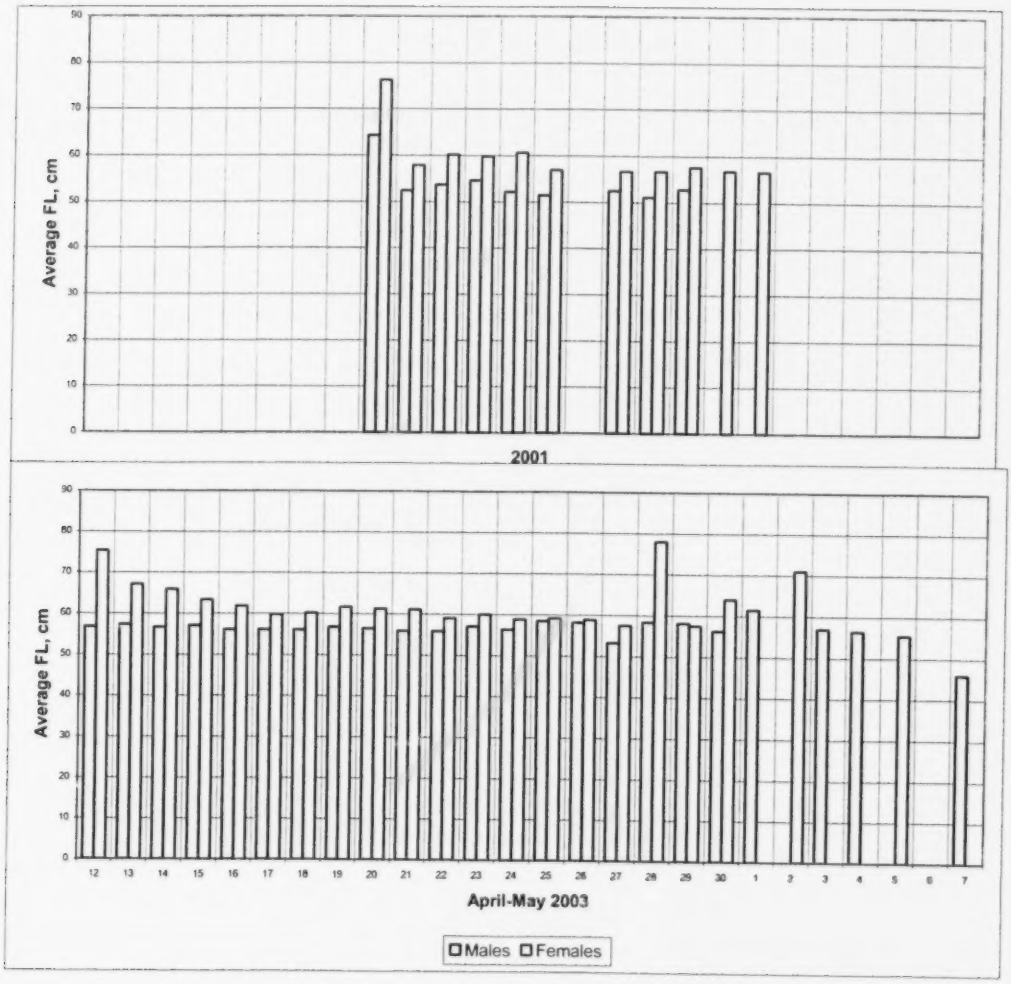

Fig. 6 Average size of female and male pike captured in Hazel Creek in 2001 and 2003.

In 2003, the first ripe female pike were noted on April 14. By April 18, almost 50% of the females were ripe, and several were spent. Percentages of ripe and spent females increased accordingly after this date:

Date (2003)	No. Examined	No. Ripe	% Ripe	No. Spent	% Spent
Apr 12	79	0	0	0	0
13	42	0	0	0	0
14	91	2	2.2	0	0
15	76	2	2.6	0	0
16	50	8	16.0	0	0
17	114	32	28.0	0	0
18	194	87	44.8	3	1.6
19	205	154	75.0	2	1.0
20	228	171	75.0	41	18.0
21	166	139	83.7	10	6.0
22	72	57	79.2	0	0
23	37	26	70.2	0	0
24	28	19	68.0	0	0

Numbers of pike caught in the trap declined after April 24, 2003.

In 2001 and 2003, walleye appeared towards the latter part of the pike run, when minimum temperature exceeded 8°C (Figs. 4 and 5). In both years, walleye runs continued into the first week of May.

In 2001, the majority of walleye appeared over two days (April 28-29), with numbers declining after April 30 (Table 1). In 2003, the majority of walleye ascended Hazel Creek between April 22 and April 30 (Table 4). Males appeared first in the spawning run, with females appearing several days later. Similar to pike, the female walleye were consistently larger than males. Average fork length of males in 2003 was 42.6 cm whereas average fork length of female was 48.6 cm (Table 7). Males outnumbered females throughout the run until the last few days, with an overall sex ratio of 2.5:1. Minimum and maximum lengths of walleye captured in Hazel Creek for both years of study is given:

	Minimum FL, cm	Maximum FL, cm
2001	37.0	65.0
2003	34.0	62.0

In 2003 the first ripe female walleye was observed on April 22:

Date (2003)	No. Examined		No. Ripe		% Ripe	
	Males	Females	Males	Females	Males	Females
Apr 20	2	0	1	0	50.0	0
21	6	0	4	0	66.7	0
22	23	6	15	3	65.2	50.0
23	27	7	9	2	33.3	28.6
24	62	12	44	0	71.0	0
25	39	5	0	0	0	0
26	30	5	0	0	0	0
27	23	3	0	1	0	33.3
28	18	13	0	0	0	0
29	20	17	20	2	100.0	11.8
30	26	10	24	4	92.3	40.0
May 1	11	11	5	2	45.5	18.2
2	7	5	7	0	100.0	0
3	8	6	0	3	0	50.0
4	4	7	0	0	0	0
5	4	15	0	7	0	46.70

Males appeared first in the spawning run, followed by females several days later. Numbers of ripe fish declined between April 25 and 28. This could be due to dropping water temperatures during that period (Table 4). Prior to April 25, temperatures had been steadily rising.

Since the fish traps were generally emptied on a diurnal basis, some comparison of fish catches during daylight hours and hours of darkness can be made. The nighttime interval also included some hours of daylight as well, so that comparisons are not strictly between day and night. Tables 8 and 9 give a comparison of pike, walleye and sucker catches during daylight hours and hours involving darkness. The overall trend for all species was an increase in catches of fish per hour during daylight in both 2001 and 2003. Pike appeared to be distinctly more active during the daylight hours: in 2001, 5.2 pike were caught per hour of daylight compared to 4.0 fish per hour of night. In 2003, 11.5 pike were caught per hour of light compared to 4.3 fish per night hour.

On April 24, 2003, adult pike were observed congregating on the upstream side of the fish fence. As described in section 2.3.1, fish were seined and released so they could return to Fishing Lake. Between April 24 and May 7, a total of 130 pike, 1 walleye, 67 white sucker and 1 perch were seined and released on the downstream side of the trap. The fish fence and trap was reversed on May 7, 2003 to capture adult fish returning to Fishing Lake.

Table 7 Sex and average lengths of walleye in Hazel Creek, April-May 2003.

	Male Walleye		Female Walleye		
Date, 2003	No.	Av FL,cm	No.	Av FL,cm	Ratio M:F
April 16	1	44			
April 17	0				
April 18	0				
April 19	0				
April 20	2	42			
April 21	6	42.7			
April 22	23	43	6	44.3	3.8:1
April 23	27	43.9	7	50.4	3.9:1
April 24	62	42.2	12	49.7	5.2:1
April 25	39	42.8	5	48.2	7.8:1
April 26	30	42.5	5	48.1	6:01
April 27	23	41.6	3	47.7	7.7:1
April 28	18	43.3	13	48.7	1.4:1
April 29	20	43.8	17	48.1	1.2:1
April 30	26	43.6	10	48.9	2.6:1
May 1	11	40.4	11	48.7	1.0:1
May 2	7	42.1	5	47.1	1.4:1
May 3	8	40.9	6	48.3	1.3:1
May 4	4	38.3	7	48.5	0.6:1
May 5	4	36.8	15	47	0.3:1
May 6					
Total	311	42.6	122	48.5	2.5:1

Table 8 Numbers and species of fish captured in Hazel Creek in 2001 during hours of daylight and hours involving darkness.

	Night				Day			
Date, 2001	Pike	Sucker	Walleye	Duration,hr	Pike	Sucker	Walleye	Duration,hr
April 20	13	1		16	5			6
April 21	105			18	157			8
April 22	293	1		16	175	4		8
April 24	32	2		18	8			7
April 25	30			17	3			6
April 27	27		1	21	3			6
April 28	93		3	15	6		2	6
April 29	79	1	11	17	12	5	23	10
April 30	3			14	1			7
May 1			1	18		1	2	7
Total	675	5	16	**170**	370	10	27	**71**
No.fish/hr	4.0	0.3	0.1		5.2	0.1	0.4	

Table 9. Numbers and species of fish captured in Hazel Creek in 2003 during hours of daylight and hours involving darkness.

Date	Night			Duration,hr	Day			Duration,hr
2003	Pike	Sucker	Walleye		Pike	Sucker	Walleye	
April 11	1	0	0	14				
April 12	284	10	0	15	264	14	0	7
April 14	155	54	0	18	177	113	0	5
April 15	76	16	0	18	148	17	0	8
April 17	180	5	0	20	152	15	0	5
April 18	233	8	0	15	264	52	0	7
April 19	242	17	0	18	186	133	0	6
April 20	232	11	2	17	182	120	0	6
April 21	147	11	5	20	122	101	2	8
April 22	96	12	19	17	75	113	10	5
April 23	61	49	21	21	7	37	13	7
April 24	55	11	51	16	20	54	22	8
April 25	22	5	32	14	5	45	14	6
April 26	4	1	10	21	7	0	25	7
April 27	5	0	16	17	3	50	11	7
April 28	7	1	22	17	1	34	10	5
April 29	4	6	27	21	0	36	20	6
April 30	2	7	32	18	3	48	5	6
May 1	1	6	20	18	0	33	2	5
May 2	1	14	11	18	0	86	1	5
May 3	0	2	5	22	6	0	9	7
May 4	1	0	9	16	1	1	2	7
May 5	0	3	17	16	1	8	2	8
May 6	0	1	0	15				
May 7	1	0	0					
Total	1810	250	299	**425**	1624	1096	146	**141**
No. fish/hr	4.3	0.6	0.7		11.5		1.0	

* Dates when the trap was only checked once during a 24-hour period are omitted from the table above, since catches during daylight and nighttime hours could not be calculated.

3.2.2 Van Pattens Creek

In 2001 the counting fence and trap was set up on April 21 through the ice just upstream from the Baptist Bible Camp. Despite the heavy snow pack in 2001, flows in Van Pattens Creek were minimal. Between April 22 and May 2, a total of 533 northern pike and 2 white sucker were captured (Table 1). It is possible that some fish were missed in the run if they swam upstream underneath the ice prior to the installation of the trap. Numbers of pike peaked on April 24 when 157 pike were caught. Water temperatures ranged from 4.5 to 11.7°C on this day, and continued to rise. Similar to the situation in Hazel Creek during the same year, the majority of the run of pike on Van Pattens Creek occurred within a few days. Figure 7 shows numbers of pike captured in the trap in 2001 against minimum, maximum and average water temperatures. Unfortunately in 2001 the lack of run-off contributed to many of the adult pike becoming stranded between beaver dams once water flows subsided.

In fall of 2001, fish enhancement staff from Saskatchewan Environment examined Van Pattens Creek to assess it for beaver dams and other obstructions to flow. In December 2001, two large beaver dams were removed, using a trackhoe.

In 2003, installation of the counting fence and trap began on April 10 at a site just downstream of the 2001 location, below the large beaver dam. Problems with ice and rapid flows inhibited installation of the trap. From April 11 to April 16, the trap was set to catch fish moving upstream, but the channel could not completely be blocked. By April 12, pike were already noted on the downstream side of the three culverts on the grid road crossing (Fig. 1). By April 13, two adult pike were observed swimming into the spawning marsh over the low level spillway. Between April 13 and 16, a total of 81 pike were captured in the trap on their upstream journey. Numbers of pike caught dropped rapidly by April 15, and it is likely that the majority of pike had gone upstream before the trap was successfully installed. Temperatures during this period ranged from a minimum of 0.7°C to a maximum of 13.3°C.

On April 17, 2003 the counting fence and trap was moved upstream and reversed. Between April 17 and May 9, a total of 1962 adult pike and 3986 white sucker were caught in the trap as they moved downstream (Table 10). Very few fish were reported stranded in the upper reaches of the creek so it is likely that the majority of them were captured in the trap on their return to Fishing Lake.

Numbers of fish returning to Fishing Lake in Van Pattens Creek were highest between April 20-23, 2003, with numbers dropping dramatically after this date. Numbers of white suckers returning were also abundant during this time period. As expected, the majority of the pike examined were spent, indicating that they had spawned in the upstream reaches of Van Pattens Creek.

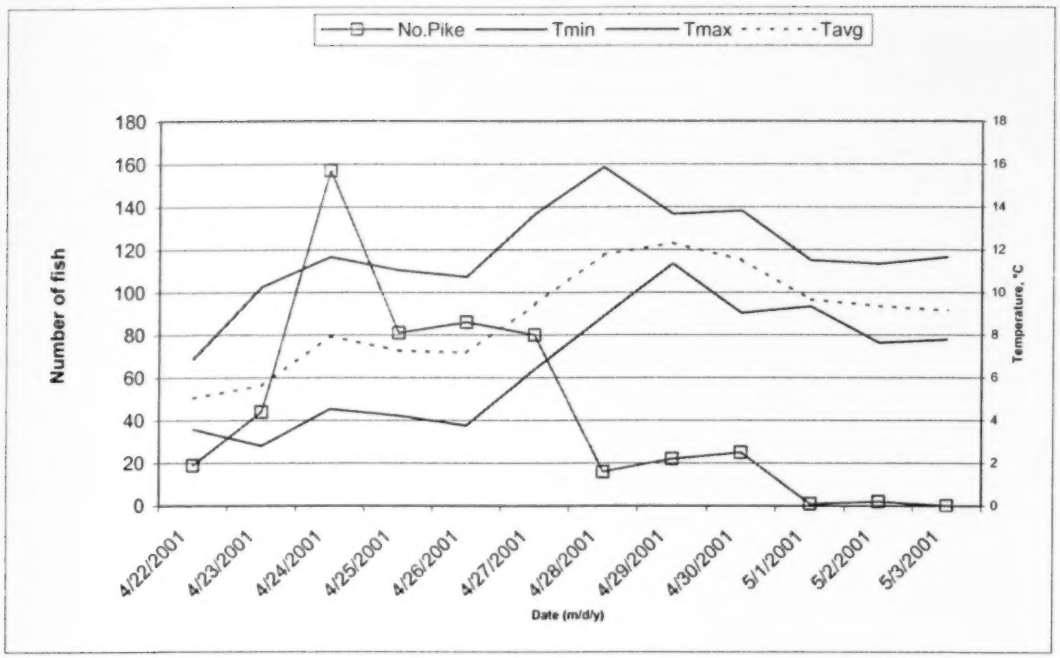

Fig. 7 Numbers of pike ascending Van Pattens Creek in 2001. Minimum, maximum and average water temperatures are indicated.

Table 10 Numbers and species of fish captured in Van Pattens Creek in 2003.

Trap installed on April 11, 2003*

Turned around and moved upstream on April 17, 2003

Date	Number of		
2003	Pike	WHSC	Temp Range, °C
April 13	46	0	3.3 - 5.4
April 14	23	0	3.7 - 6.6
April 15	10	0	3.7 - 5.8
April 16	2	0	0.7 - 13.3
Total	**81**	**0**	
April 17	Trap turned around and moved upstream*		
April 18	59	914	
April 19	78	1404	
April 20	513	625	
April 21	796	516	
April 22	92	0	
April 23	172	18	
April 24	63	13	
April 25	36	42	
April 26	20	24	
April 27	13	19	
April 28	7	0	
April 29	13	53	
April 30	10	55	
May 1	16	56	
May 2	12	21	
May 3	17	83	
May 4	12	15	
May 5	10	90	
May 6	8	31	
May 7	7	2	
May 8	3	0	
May 9	5	5	
Total	**1962**	**3986**	

*Fast flows and eroding ice on the creek bottom prevented proper installation of the fish fence. The majority of fish moving upstream were missed, but were captured on their downstream journey when the trap was reversed.

Tables 11 and 12 indicate the sex ratio and sizes of pike for 2001 and 2003. Similar to the trend in Hazel Lake, females were larger than males: average fork length for females caught in 2001 was 56.2 cm while males averaged 51.4 cm (Fig. 8). Female pike averaged a fork length of 59.8 cm in 2003, substantially longer than the average length of males at 55.3 cm. Numbers of pike returning had a sex ratio of 1.1:1 in favour of males. There appeared to be no trend for either larger fish or males to ascend first. Unlike Hazel Creek, in 2001 female pike dominated the spawning run at Van Pattens (0.3:1 in favour of females). Minimum and maximum lengths of pike captured in Van Pattens Creek for both years of study are given:

	Minimum FL, cm	Maximum FL, cm
2001	43.4	86.7
2003	44.0	67.0

In 2001 the first ripe female pike was noted on April 22, and numbers of females ready to spawn increased after this date:

Date (2001)	No. Examined	No. Ripe	% Ripe
Apr 22	6	3	50.0
23	32	28	87.5
24	122	92	75.4
25	74	65	87.8
26	63	52	82.5
27	57	46	80.7
28	13	11	84.6
29	12	12	100.0
30	15	15	100.0
May 1	0	0	
2	1	1	100.0

No spent pike were observed in 2001.

Similar to the trend observed in Hazel Creek, pike in Van Pattens Creek tended to be more active during hours of daylight. As indicated in Table 13, 5.3 pike were caught per hour of daylight in 2001, as compared to 1.4 fish captured per hour of darkness.

Since the majority of the pike captured in 2003 were taken as they moved downstream following spawning, trends in activity levels between hours of daylight and darkness were not examined.

No walleye were observed in Van Pattens Creek in 2001 or 2003.

Table 11 Sex and average lengths of pike in Van Pattens Creek , 2001.

	Male Pike		Female Pike		
Date 2001	No.	Av FL,cm	No.	Av FL,cm	Ratio M:F
April 22	12	50.0	6	55.6	2.0 : 1
April 23	10	50.7	32	57.5	0.3 : 1
April 24	31	52.5	124	57.5	0.3 : 1
April 25	4	51.5	75	55.7	0.1 : 1
April 26	20	51.9	63	55.3	0.3 : 1
April 27	17	50.6	58	55.5	0.3 : 1
April 28	3	52.2	13	53.5	0.2 : 1
April 29	9	51.4	12	56.1	0.8 : 1
April 30	11	50.6	14	55.5	0.8 : 1
May 1	0		1	55.8	
May 2	1	58.5	1	57.2	1.0 : 1
Total	118	51.4	399	56.2	0.3 : 1

Table 12 Sex and average lengths of pike in Van Pattens Creek, 2003.

	Male pike		Female pike		
Date 2003	No.	Av FL,cm	No.	Av FL,cm	Ratio M:F
April 13	21	54.8	19	56.6	1.0 : 1
April 14	13	54.1	8	59.6	1.6 : 1
April 15	3	53.0	5	65.3	0.2 : 1
April 16	1	55.5	1	45.0	1.0 : 1
April 17					Trap reversed
April 18	23	54.2	36	57.9	0.6 : 1
April 19	17	58.9	60	59.3	0.3 : 1
April 20	243	55.9	265	59.1	0.9 : 1
April 21	420	55.1	370	59.7	1.1 : 1
April 22	40	55.6	51	60.3	0.8 : 1
April 23	112	55.0	59	59.5	1.9 : 1
April 24	43	53.7	19	58.6	2.3 : 1
April 25	40	55.6	9	65.4	4.4 : 1
April 26	29	56.3	2	94.7	14.5 : 1
April 27	11	56.3	0		
April 28	4	52.6	1	73.0	4.0 : 1
April 29	6	54.5	7	59.7	0.9 : 1
April 30	5	54.3	4	57.5	1.3 : 1
May 1	6	54.8	10	61.8	0.6 : 1
May 2	9	56.8	3	61.0	3.0 : 1
May 3	9	57.4	8	59.4	1.1 : 1
May 4	5	58.6	7	73.8	0.7 : 1
May 5	4	55.6	5	69.4	0.8 : 1
May 6	5	53.9	3	62.3	1.7 : 1
May 7	5	54.4	1	64.4	5.0 : 1
May 8	2	53.5	1	60.0	2.0 : 1
May 9	1	59.0	3	56.0	0.3 : 1
Total	1039	55.3	924	59.8	1.1 : 1

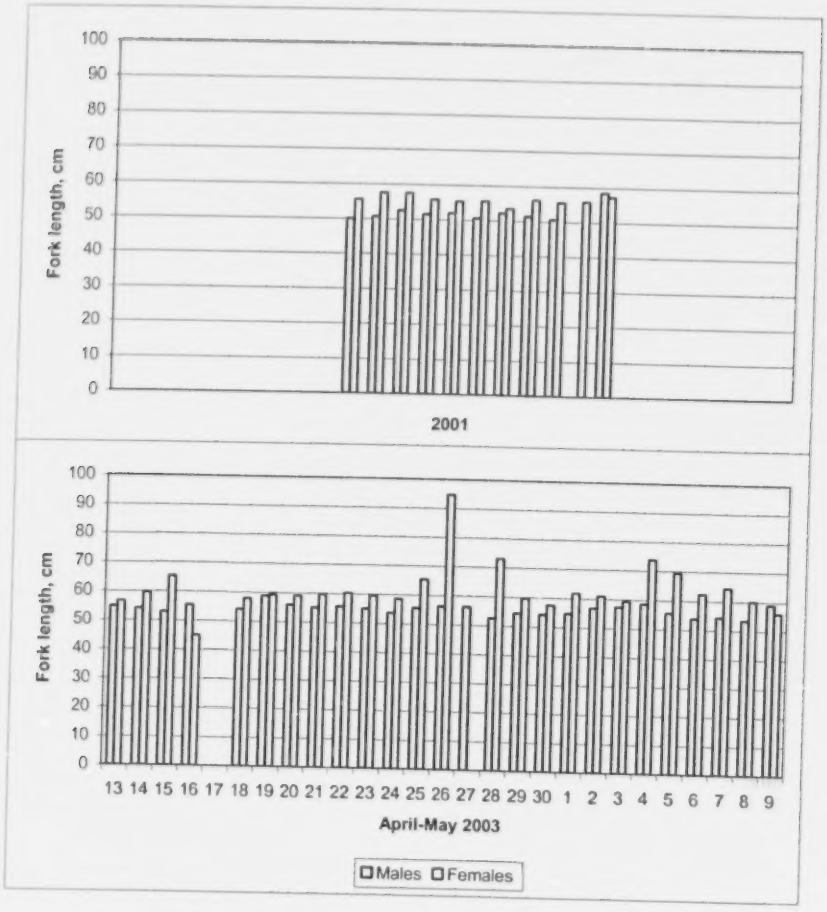

Fig. 8 Average size of male and female pike captured in Van Pattens Creek in 2001 and 2003.

Table 13 Numbers of pike captured in Van Pattens Creek in 2001 during hours of daylight and hours involving darkness.

	Night		Day	
Date, 2001	Pike	Duration,hr	Pike	Duration,hr
April 22	2	24	17	4
April 24	82	22	75	6
April 25	19	19	26	5
April 26	49	18	37	6
April 27	27	18	53	7
April 28	11	17	5	4
April 29	18	20	4	6
April 30	11	18	14	6
Total	219	**156**	231	**44**
No. fish/hr	1.4		5.3	

3.2.3 Franks Creek

In 2001, the culverts in the access road to Buckhorn Bay, where Franks Creek flows into Fishing Lake, were collapsed, blocking fish passage into this tributary. No further assessment was carried out during this year. The two culverts (610 mm x 7.4 m round and 1525 mm x 1220 mm x 7.4 m arch) were replaced by a single round culvert (1600 mm x 17 m) later that fall.

Although lack of spring flows in 2002 prevented assessment of tributary streams, bays and marshes were visually inspected for pike adults and developing eggs. On April 28, 2002, personnel from Saskatchewan Environment noted fish in the Buckhorn Bay culvert where Franks Creek flows into the east basin (Fig. 1). On April 30, 2002, a 30 m gillnet was set across the discharge end of the culvert to determine if fish accessed the area. The net was checked several times during the day, and at 9:00 pm, one male pike approximately 55 cm in length was captured and released. Although the net was left overnight, no more fish were caught.

On May 15, 2002, gillnets were set in Buckhorn Bay in Fishing Lake and left for the day. By 5:30 pm, no fish had been captured and the net was removed. Dipnet sampling of the vegetation in the marsh at the mouth of Franks Creek yielded no pike eggs.

A pound trap was set on April 18, 2003 on the downstream side of the culvert at Buckhorn Bay where Franks Creek enters the east basin (Fig. 1). A total of 155 pike were trapped in the net between April 19 and 20, 2003. These fish were returning to the lake after ascending the tributary. It is unknown how many fish were missed returning to the lake before the net was installed. No walleye or white sucker were observed.

Average fork lengths of the male and female pike captured in the net is given:

Date 2003	No. Males	Av FL, cm	No. Females	Av FL, cm	Ratio M:F
April 19	66	55.3	55	58.5	1.2 : 1
April 20	18	58.4	14	58.7	1.3 : 1
Total	84	55.9	69	58.5	1.2 : 1

Female fish were larger than the males, with an average fork length of 58.5 cm as compared to 55.9 cm for males. Males outnumbered females by a ratio of 1.2 : 1. Minimum fork length of pike captured was 45.0 cm; maximum length was 70.0 cm. All but two females captured were either ripe or spent. Although the net remained in place for several days after April 20, no more fish were captured.

3.2.4 Other Sites

On April 25, 2001 the large marsh adjacent to the east basin at N ½ 12-33-12 W2 was examined by wading and visually inspecting the area. Adult pike were noted in the marsh. The marsh was approximately one to two feet deep at this time. This marsh drains into the lake near Leslie Beach, and local residents indicated that this was an area where poaching occurred in past years when large pike swam into the marsh.

3.3 REPRODUCTIVE SUCCESS

3.3.1 Hazel Creek

Dipnetting for eggs in Hazel Creek at its outlet from Hazel Lake and at the Highway 310 crossing was carried out in April 2003 (Table 14). At Hazel Lake approximately 50 m downstream from the outlet, eight eggs were collected in a 20-minute sampling period in the flooded grasses and weeds.

At the Highway 310 culvert, sampling for eggs on April 25 was not successful. However, egg sweeps on April 27 for a 45-minute period about 250 m upstream from the Highway 310 culvert collected 81 eggs. The majority of eggs were captured in 3 sweeps (each about 60 second duration) in flooded grasses in depths of approximately one foot.

Numbers of young-of-the- year pike captured in the Hazel Creek system between May 2 and July 4, 2003 is given in Table 14. Over 900 pike fingerlings were captured in the hoop nets set below the culvert on Highway 310. This number excludes the pike fry caught in the fry traps during the May 21-22nd sampling since enumeration was not carried out on these dates. Other species captured at this location included adult pike, walleye, perch and sucker, and a fathead minnow.

Number of young-of-the-year fish captured in the gear set below the culvert on the grid road crossing consisted of 62 pike fingerlings (Table 14), significantly less than caught in the nets set downstream at 310. Of interest are the 14 walleye fingerlings that were collected at site number 3 (Fig. 3). The fingerlings were captured both above and below the grid road culvert. A rough approximation of 15 500 young-of-the-year pike returned down Hazel Creek between May 29 and July 4, 2003, based on extrapolations using numbers of fish captured per hour in the hoopnets. Similar extrapolations suggest that about 150 young-of-the-year walleye moved down Hazel Creek to Fishing Lake during the same time period. Other fish species captured by the nets set on Hazel Creek included adult pike, perch and numerous fathead minnows. The capture of perch moving downstream is surprising, as none were sampled moving upstream. It is likely that these fish were small enough to pass through the spaces between the conduit in the fish fence.

By June 9, young-of-the-year pike had reached a size of 5-6 cm in length. Sampling during July 3 revealed that pike were up to 15 cm in length. Walleye fingerlings were approximately 3-4 cm in length when first collected on June 17, 2003.

3.3.2 Hazel Lake

In 2001, gill netting and seining was carried out in Hazel Lake to determine if fish could ascend into Hazel Lake and successfully reproduce. Gillnets set in April captured two adult walleye, indicating that fish could move successfully up into the lake. August gillnet sets during the same year captured 10 young-of-the-year pike, which ranged

Table 14. Hazel Lake and Creek investigations during April-July, 2003.

Date, 2003	Gear-duration	Hazel Ck-downstream Of Highway 310	Hazel Ck Downstream of grid	Hazel Lake
April 25	Sweep net	No eggs		
April 26	Sweep net	81 eggs	8 eggs	
April 24-May 1	Seine	60 adult pike 26 adult white sucker		
May 2	Seine	19 adult pike 2 white sucker		
May 3	Seine	19 adult pike 34 white sucker		
May 4	Seine	10 adult pike 2 white sucker		
May 5	Seine	2 adult pike 1 white sucker		
May 6	Seine	1 adult walleye		
May 7	Seine	20 adult pike 1 perch 1 white sucker		
May 21-22	Fry trap: 21 hr	Pike fry-unquantified	Pike fry-unquantified	
May 29	Hoop net: 3 hr	263 pike y-o-y (1-2")	1 adult pike 10 pike y-o-y 60 fathead minnows 1 perch	
	Seine	1 adult pike 2 pike fingerlings	3 adult pike 35 pike fingerlings 4 perch	1 pike fingerling 1 spottail shiner 2 fathead minnows
May 30	Hoop net: overnight	558 pike fingerlings 3 adult pike	1 pike fingerling 1 adult pike 56 fathead minnows	
	Hoop net: 4 hr	43 pike fingerlings	2 pike fingerlings 30 fathead minnows	
	Seine	Noted pike fingerlings swimming against current in culvert	1 pike fingerling	No fish 40 m S of mouth
June 9-10	Fry trap	No fish (overnight set)	1 unidentified fish (total set was 4 hr)	
	Seine		1 fathead minnow 2 pike fingerlings (2")	3 brook stickleback
June 17	Hoopnet: 8 hr	10 pike fingerlings 1 fathead minnow	4 pike fingerlings 5 walleye fingerlings fathead minnows stickleback	
	Seine		Fathead minnows Sticklebacks	
June 18	Hoop net: overnight	9 pike fingerlings 1 perch	No fish-net chewed	
	Seine		5 walleye fingerlings 20 m upstream of grid	
July 3-4	Hoop net: overnight	15 pike fingerlings	9 pike fingerlings (3-6") 4 walleye fingerlings	S basin:DO<1.0 mg/L at sunrise: N basin 6.22 mg/L
	Seine		No fish (upstream)	
	60 m gillnets set overnight			9 adult pike 2 white sucker
Total numbers		**81 eggs** **900 pike fingerlings** **134 adult pike** **1 adult walleye** **2 perch** **66 adult sucker** **1 fathead minnow**	**8 eggs** **62 pike fingerlings** **5 adult pike** **14 walleye fingerlings** **5 perch** **146 fathead minnows**	**1 pike fry** **9 adult pike** **2 white sucker** **1 spottail shiner** **2 fathead minnow** **3 brook stickleback**

in size from 26 to 29 cm, and weighed from 150 to 210 g. Analyses of stomach contents revealed that the pike were feeding on fish, primarily stickleback. Seine hauls carried out in August 2001 were unsuccessful in capturing any gamefish but did catch stickleback.

In 2003, gillnets and seines were used to assess movement of adult fish into Hazel Lake and to evaluate reproductive success (Table 14). On May 29, one pike fingerling was captured using a seine net. Gillnetting in July captured a total of 9 adult pike as well as 2 white suckers.

3.3.3 Van Pattens Creek

Dipnetting for eggs in Van Pattens Creek on April 26, 2003 yielded 14 pike eggs within 5 minutes of sampling. These eggs were collected in flooded grasses at the grid road crossing.

Reproductive success of pike swimming up Van Pattens Creek was evaluated by operating the pike spawning marsh in 2003. Between June 4-8, a total of 183 000 pike fingerlings were trapped as they exited the marsh during draining, and transported to various locations on Fishing Lake for stocking. A sub-sample of pike was retained for analyses. These fish ranged in fork length from 6.0 to 6.5 cm and weighed from 1.6 to 2.5 g. Examination of stomach contents indicated that they were feeding on cladocerans and chironomid larvae.

Numbers of pike produced in areas downstream of the spawning marsh is unknown. However, the collection of eggs in the marshy area adjacent to the grid road crossing in April 2003 indicates that reproduction is occurring in the lower reaches of the creek.

3.3.4 Other Sites

On May 23, 2001 the large marsh adjacent to the east basin at N ½ 12-33-12 W2 was examined for pike reproduction. Adult pike had been observed earlier in April exhibiting spawning behaviour in this same marsh. Although two hours were spent dipnetting in the vegetation, no fry or fingerlings were captured. By late June, this marsh was almost dry.

Dipnetting for pike eggs was carried out on May 16, 2002 in McCormick Bay, Hazel Bay, Fish and Game Beach in the east basin, and at the mouth of Van Pattens Creek in the west basin (Fig. 1). No eggs were collected. Sampling may have occurred too late in the season to capture pike still in the egg stage.

Egg sweeping was carried out at Feedlot Creek at 3-34-12 W2 on April 26, 2003. Twenty minutes of sweeping captured 5 eggs.

The marsh on the point between the two lake basins at 13-33-12 W2 was sampled on April 26, 2003. Members of the Fishing Lake Indian Reserve reported pike spawning activities in previous high water years. Ten minutes of effort collected no eggs. The lack of suitable vegetation may have prevented pike from using this area. The grassy areas in

the foreshore areas exposed at the time of the survey would likely provide good spawning grounds in years of higher water levels.

3.4 SEASONAL MOVEMENTS OF ADULTS

Tracking of the 10 adult pike implanted with ultrasonic transmitters was carried out every few weeks during the open water season in 2001, and monthly during periods of ice cover. As spring, 2002 approached, tracking was conducted more frequently in order to identify potential spawning locations.

Table 15 indicates dates and locations when tagged fish were observed. With the exception of one pike tagged in the west basin, all fish were located at least once. Several of the fish were captured by anglers and kept: within one month of tagging, pike # 78-444 was captured off Knights of Columbus Subdivision and kept. The transmitter was returned to Saskatchewan Environment, and it was subsequently re-implanted in another pike caught in the west basin on October 11, 2001.

Although there was very little spring run-off in 2002, five of the pike tagged in the east basin near Hazel Creek inlet were located in the Hazel Bay vicinity during April-May of that year. In May 2003, pike # 77-333 was captured in Hazel Creek. This suggests that pike are exhibiting some homing behaviour to traditionally used spawning areas, even in years where there is lack of flows.

The second host pike for tag # 78-444 was captured by First Nations individuals fishing on Hazel Creek on April 16, 2003. This indicates that some movement of fish between the two lake basins occurs.

Between April 24 and July 4, 2003, sampling was carried out in Hazel Creek and Hazel Lake to determine movements of adult pike into the lake and to assess numbers returning to Fishing Lake. Gear used included seine net, gill net, hoop net and fry trap. Results are given in Table 14. A total of 134 adult pike were captured in seine nets employed between Highway 310 culvert and the counting fence. These fish were captured as they congregated against the fence on their return to Fishing Lake. They were released on the downstream side of the trap. Only five adult pike were caught in gear used in Hazel Creek downstream of the grid road. Nine adult pike were captured in Hazel Lake itself in the gillnet set on July 3, 2003.

3.5 DETERMINATION OF THE DOMESTIC HARVEST

The three First Nations Reserves located in the Fishing Lake vicinity have traditionally fished on tributaries to Fishing Lake. Members from the reserves (Fishing Lake, Yellowquill and Kinistin) typically take advantage of the spring spawning runs of pike on Van Pattens Creek, using either a snare or dipnet. Occasionally, fishing occurred at other creeks flowing into Fishing Lake. Gillnets are also set through cracks in the ice in the west basin during spring break-up to catch walleye (B. Desjarlais, pers. comm.).

Table 15. Locations and dates where pike implanted with sonic transmitters in Fishing Lake were identified, 2001 – 2003.

Tag #	Origin	FL (cm)	27-05-01	28-05-01	21-06-01	22-06-01	23-06-01	05-07-01	27-07-01	18-08-01	16-09-01	11-10-01	10-01-02	14-03-02	15-03-02	02-04-02	16-04-02	16-05-02	29-05-02	05-01-03	16-04-03	04-05-03
72-227	East basin	57.5	Mouth of Hazel Ck											K of C	moved 1/2 km to Hazel	SE of Knights of Columbus	near Hazel off Ottman					
72-234	West basin	103									Buckhorn Bay (4m)											
73-345	East basin	91.2											W side Leslie Beach (13U 0600537 5743004)	E side Leslie		SE of Knights of Columbus			Off Saskin Beach			
73-378	East basin	100														Ottman Beach	near Hazel-closer to Ottman					
75-389	East basin	83		Mouth of Hazel Ck (3 m)					W point Cherney/ Leslie Beach (5m)	Leslie Beach (25ft)			East basin - Shallow Bay to S of where lbasins join (13U 0598859 5744039)						South of narrows between the two lbasins-captured & kept		
75-468	East basin	108						E side Leslie (20m)			Buckhorn Bay (4m)		Knights of Columbus (13U 0604518 5740496)		13U 0604293 5740487							
76-236	West basin	56.5																*Not found to date				
76-259	West basin	60.3																off launch on west basin				
77-333	East basin	100.5												Ottman Beach	moved 1/2 km towards Hazel		off Hazel					Caught at Hazel Ck by First Nations
78-444	East basin	77			E side Ottmans Beach (3m water)	Ottmans Beach/ K of C	Knights of Columbus captured & kept															
*78-444	West basin	64.7										Tag re-implanted & released at Bible Camp-west basin								Caught at Hazel Ck by First Nations	

*Pike # 78-444, tagged in Big Fishing Lake in May 2001, was captured on June 23 2001 by angler. Transmitter was returned to SE, and another pike, captured in Little Fishing Lake, was tagged on October 11 2001.

In 2001, domestic fishing occurred on both Van Pattens Creek and on Hazel Creek. Pike were taken by dipnet or snare as they moved upstream to spawn. Approximate numbers of fish taken by treaty fishermen were recorded, and it is estimated that 125 fish were harvested during that spring. The majority of fish came from Van Pattens Creek, and consisted mainly of pike. In one evening, almost 80 pike were taken from the creek.

In 2003, two members from the Fishing Lake First Nation interviewed all families that were fishing. With the exception of one individual, all members voluntarily reported the numbers of fish harvested:

	No. Pike	No. Walleye	No. Sucker	Total
Van Pattens Creek	1312	0	0	1312
Hazel Creek	747	7	0	754
Fishing Lk*	151	277	251	679
Total	2210	284	251	2745

* Gillnet set in the west basin.

Members from the Kinistin Saulteaux Nation did not actively participate in the spring fishing during 2003. The First Nation members were very co-operative about providing information on their catch, and stated that all fish were utilized.

4. DISCUSSION

Results obtained from field studies carried out during 2001 and 2003 indicate that Van Pattens Creek and Hazel Creek are both important tributaries for pike reproduction. Other tributaries are used to some extent, as shown by the capture of pike descending Franks Creek into Buckhorn Bay. The collection of eggs in Feedlot Creek indicates that fish are also using this creek for reproduction.

Pike reproduction within Fishing Lake itself appears to be limited. Numerous attempts to collect eggs, fry and fingerlings with a variety of gear in vegetated bays during the present assessment and in past surveys in the lake were unsuccessful (Merkowsky 2005). These techniques did capture eggs, fry and fingerlings in the tributaries. The tributaries also are important areas for the reproduction of the other fish species, including walleye and white sucker. Although Hazel Lake and Creek do not provide typical walleye spawning habitat (cobble, gravel), this species did successfully reproduce within the system. Other investigations by Saskatchewan Environment in the Candle Lake area revealed that walleye successfully spawned on vegetated mats of *Chara* in the Torch Lake system (M. Koob, pers. comm.).

Numbers of fish ascending the creeks appear to be largely dependent on flow conditions, with increased flows resulting in larger numbers of fish. The higher flows experienced in 2003 caused some problems with pike passage through the culvert on the grid road just below Hazel Lake. Adult pike and sucker were observed congregating at the downstream side of the culvert for several days before reduced flows allowed them to access the lake.

Pike appeared to react to increasing water temperatures and resulting increased flows as a stimulus to ascend the creeks, with water temperatures above 4-5°C serving as an attractant. Warmer water temperatures in 2003 resulted in pike ascending Hazel Creek more than a week earlier than in 2001. In 2001, the run occurred over a brief few days, and dropping temperatures did not cause an interruption in the run. However, dropping temperatures in 2003 resulted in a decline in numbers of pike ascending Hazel Creek for a day or two before recovering. Spawning activity in both years continued until the first week in May. Therefore, although water temperature appears to be a major factor in triggering pike to move upstream, day length may also be a cue, with later runs continuing regardless of changing water temperatures.

Female pike tended to be larger in size than males, a trend evident in all three tributaries that were assessed. Average sizes of males and females were larger in Hazel Creek than in the other tributaries. Average fork length of both sexes was slightly greater in 2003 as compared to 2001. There was a tendency for male pike to ascend the creeks first, and in general males outnumbered females with the exception of Van Pattens Creek in 2001. Size variation suggests that larger fish tend to run first. Comparison of diurnal catches indicates that the pike were more active during hours of daylight.

Walleye appeared in Hazel Creek in both 2001 and 2003 towards the end of the pike run, when water temperatures stayed above 8°C. Similar to pike, the female walleye were larger in size than males. Male walleye appeared first in the creek, and predominated the sex ratio in 2003.

Large amounts of spring run-off in 2003 filled the pike spawning marsh on Van Pattens Creek. A record production of 183 000 fingerlings reveals the importance of high spring flows to the success of pike reproduction.

Adult pike swimming up Van Pattens Creek into the marsh appeared to return immediately to the lake following spawning, as indicated by the capture of almost 2000 pike moving downstream to Fishing Lake in 2003. No adults were observed in the marsh or in upstream areas once the marsh was drained, suggesting that the majority of adults that spawned did return to Fishing Lake.

Alternately, adult pike using the Hazel Lake system did not appear to return to Fishing Lake following spawning. Follow-up seining and trapping of adults moving back downstream collected very few fish. Due to the low numbers of pike caught, it is not feasible to extrapolate to obtain an estimate of total numbers of adult pike returning to Fishing Lake. The information collected does suggest that the majority of the 3794 pike captured in the fish trap in Hazel Creek in 2003 as they swam upstream did not return to Fishing Lake. Warm water temperatures and an abundance of food (minnows) may have enticed the pike to remain in Hazel Lake. Similar results have been documented in other studies (Franklin and Smith 1967) with pike staying in the nursery areas for an extended time period. Since oxygen levels are too low to sustain fish during both winter and summer in Hazel Lake, it is possible that the adult pike and any fingerlings perished. There is also the possibility that the adult pike moved from Hazel Lake downstream into Usinneskaw (Stoney) Lake.

The majority of young-of-the-year pike captured in the Hazel Creek system were collected below the culvert on Highway 310 as compared to relatively few taken downstream of the grid road culvert. This suggests that the marshy channel between the two culverts is an important spawning area for pike recruitment to Fishing Lake.

Results obtained from tracking adult pike suggest that pike in Fishing Lake may return to the same spawning areas in subsequent years, regardless of the intensity of spring flows. Some mixing of the populations between the two lake basins does occur when water levels are adequate.

The domestic fishery on Fishing Lake is concentrated on spring runs of pike in the tributaries, with fish being taken on their upstream journey prior to spawning. Although Van Pattens Creek has been the traditional area for fishing, members of the local bands also utilized the pike in Hazel Creek in both 2001 and 2003.

In 2003, the domestic fishery harvested over 1300 pike as they swam up Van Pattens Creek, which could amount to 40% of the total pike run assuming that all fish that went upstream were captured in the fish traps as they moved downstream. Despite a substantial harvest of fish from this tributary, the record production from the spawning marsh indicates that the domestic fishery does not appear to be having a significant impact on the fish populations during years of high flows. Observations made during field studies in 2001 and 2003 indicate that the domestic fishery is more active during higher water flows when fish are more abundant. In years of low flows, little fishing takes place so the fishery is somewhat self-regulating.

When the domestic harvest of 2494 gamefish (pike and walleye combined) taken in 2003 is compared to the sport fish harvest of 46 500 gamefish estimated in 2000 during the open water season (Merkowsky 2005), it is apparent that the domestic fishery is a minute component of the fishery. No commercial fishery operates on Fishing Lake so utilization of the resource is largely through the sport fishery with minimal harvest by the small domestic fishery. Angling limits on Fishing Lake were recently lowered to Catch and Release Type 1, following the angler survey carried out in 2000 and resulting consultation with stakeholders.

5. MANAGEMENT CONSIDERATIONS

Van Pattens Creek and Hazel Creek provide important spawning areas for pike in Fishing Lake. The high water levels and resulting flood conditions experienced in the late 1990s have been a concern to residents living around the lake. The Fishing Lake Watershed Association has proposed that a control structure be installed on the grid road immediately downstream from Hazel Lake. During periods of high run-off, the gate would be closed to divert water eastward from Hazel Lake and prevent it from reaching Fishing Lake. However, the spring fieldwork carried out in 2001 and 2003 indicates the importance of flow to attract pike upstream. If this proposal were pursued, then it would need to operate in a manner to provide sufficient flows downstream to Fishing Lake. The run-off event in 2003 was determined to be a Q7 event (SWA pers. comm.), which provided suitable water flows.

Several of the culverts in the Fishing Lake area have been recently replaced. The culvert on the grid road crossing at Hazel Lake prevented fish from accessing Hazel Lake for several days in 2003 due to high flow velocities. However, because the culvert held water back, the entire area between Hazel Lake and Fishing Lake contained water for an extended time period, allowing the pike to successfully reproduce and the eggs to hatch and develop. Since Hazel Lake does not appear to be as important for successful pike reproduction as the downstream channel, and because the adult pike that entered Hazel Lake appear to remain in Hazel Lake where they likely do not survive, preventing fish from accessing Hazel Lake may be beneficial to the pike population of Fishing Lake. Ample spawning habitat appears to be available between Hazel Lake grid and Highway 310.

The domestic fishery does not appear to be having an impact on the pike population, therefore there does not appear to be justification for keeping the extended closure on Van Pattens Creek due to conservation reasons. Consultation was carried out with the Fishing Lake Co-Management Committee at the December 2003 meeting, and the committee was in agreement with lifting the closure. It is anticipated that the closure will be lifted for the next angling season, and Van Pattens Creek would be open to all fishing. The sport fishery would continue to be regulated by provincial limits (CR1) and southern management zone opening dates.

6. FURTHER STUDY NEEDS

- The channel between the Hazel Lake grid and Highway 310 should be visually inspected to determine its use by spawning adult fish.
- Fieldwork carried out in May and June suggests that Hazel Lake is not as important an area for successful pike reproduction as areas in the downstream channel. Since oxygen levels in Hazel Lake are unsuitable for fish survival during both winter and summer, preventing adult fish from accessing Hazel Lake may be a consideration. It is recommended that a temporary blockage be installed in spring to prevent access so that fish reproduction within the downstream channel can be investigated. Follow-up work was carried out during the spring of 2004, and results are presented in Appendix 1.

- Reproductive success of gamefish should be assessed, similar to techniques used in 2003. Installation of a hoop net in the channel and below Highway 310 culvert approximately every 7-10 days should provide some estimates of fingerling numbers. Seining and fry traps could also be employed.
- Walleye populations in Fishing Lake have been maintained by stocking fry every two years. Until this past year, it was assumed that no natural reproduction of the species was occurring. However, the capture of 14 walleye fingerlings in Hazel Creek indicates some successful reproduction is occurring within tributaries. Since 2001, fry stocked in the lake have been marked with oxytetracycline, an antibiotic that stains the bony structures in the fish. Gamefish populations in Fishing Lake should be assessed in 2005, and any walleye captured should be examined for marks to determine the contribution of the stocking program to the fish population.

7. RECOMMENDATIONS

- Measures necessary to ensure fish habitat is protected in Hazel Creek, Van Pattens Creek and Buckhorn Bay should be considered. Ideally, easements could be obtained for critical habitat areas such as the large grassy channel within and surrounding Hazel Creek.
- The spawning marsh on Van Pattens Creek should continue to be operated. It is anticipated that the Kuroki Wildlife Federation will play an active role in the operation of the pond. In years of adequate run-off, consideration should be given to flushing the fish downstream instead of trapping and moving them. If feasible, a net should be installed at the mouth of the creek to ensure that the fingerlings successfully move down into Fishing Lake.
- Beavers tend to be very active on Van Pattens Creek, and the dams often cause problems for fish passage. It is recommended that local groups be contacted to see whether a beaver control program could be initiated to control the animal population and keep the channel open. The local Saskatchewan Wildlife Federation or First Nations may be interested.
- There is no justification for keeping the extended closure on Van Pattens Creek for conservation reasons. It is recommended that this closure should be lifted.
- Saskatchewan Environment is currently working on a long-term strategy on fisheries management for the province. Therefore no immediate management changes are feasible at the current time.

8. LITERATURE CITED

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Appendix 1. Follow-up work carried out in 2004.

Further work was carried out from April 13 to June 25 in 2004 to monitor use of Hazel Creek itself for fish reproduction. A metal fish barrier was installed at the downstream side of the culvert on the grid road, effectively preventing adult fish from ascending into Hazel Lake. It remained in place from April 13 until June 25. Visual observations were made once every week until end of June. At the same time, a hoop net was installed downstream of the culvert on Highway 310 to sub-sample numbers of adult fish and young-of-the-year moving back into Fishing Lake. Water quality measurements and flows were also measured. Results are given in the tables below. Relatively low flows were encountered during the spring of 2004, and locals reported that few fish were observed moving up Hazel Creek. The information provided below indicates that although few adult fish were captured, successful reproduction within Hazel Creek occurred.

Hazel Lake and Creek Investigations during April-June, 2004.

Date 2004	Gear-duration	Hazel Creek Downstream of Hyw 310	Hazel Creek Downstream of grid	Hazel Lake
April 13	Metal fish barrier			Installed fish barrier*
April 22	Hoop net: Overnight	15 adult pike		
April 28	Hoop net: Overnight	9 adult pike		
May 6	Hoopnet: Overnight	0 fish		
May 13	Hoopnet: Overnight	2 Iowa darter		
	Seine		No fish	
May 20	Hoopnet: Overnight	0 fish	1 pike caught inside fish barrier	
	Seine	Upstream of hwy:0 fish	Downstream: 0 fish	
May 27	Hoopnet: Overnight	Few stickleback 1 darter		
	Seine	Between culvert & trap 0 fish	4 stickleback	
June 3	Hoopnet: Overnight	16 darter 12 stickleback 1 white sucker y-o-y		
	Seine	Culvert to trap 1 stickleback	4 seines caught: 9 stickleback 1 darter	
June 17	Hoopnet: Overnight	101 pike fingerlings 24 fathead minnow 6 darters 1 shiner 1 stickleback		
	Gillnet: Overnight			No fish
June 24	Hoopnet: Overnight	30 pike (2-5 cm) 10 fathead minnow		
	Seine		2 seines caught 1 pike fingerling 1 stickleback	
June 25				Removed fish barrier

*Metal fish barrier installed to block fish passage into Hazel Lake. Pike and sucker noted immediately up against barrier. Some fish had already moved into Hazel Lake.

Hazel Creek water quality results, 2004.

Highway 310 culvert

Date	Time	Temperature °C	pH	Conductivity µS/cm	Velocity m/sec Inlet	Outlet
April 22	1400	7.7	8.22	588	0.81	0.86
April 23	1000	5.7	7.94	590	0.91	0.87
May 6	1445	8.5	8.54	1020	0.56	0.63
May 7	0830	7.6	8.41	1050	0.55	0.63
May 13	1400	8.5	8.80	1080	0.47	0.51
May 14	1000	6.9	8.80	1010	0.45	0.48
May 27	1400	13.9	8.10	1170	0.38	0.37
June 3	1500	21.6	7.78	1270	0.29	0.31
June 17	1530	13.9	7.47	1230		
June 24	1530	15.3	7.74	1250		

Grid Road Culvert

Date	Time	Temp °C	pH	Conductivity µS/cm	Velocity m/sec Inlet	Outlet	Comments
April 23	1045	6.7	7.55	688	0.89	0.97	1 in of headspace
May 6	1500	9.1	8.74	1020	0.33	0.43	Water level 8 in below top of culvert at inlet, level with culvert at outlet.
May 7	0940	8.0		1020	0.37	0.36	
May 13	1430	8.6	9.14	1090	0.30	0.32	
May 14	1030	7.0	9.18	1040	0.29	0.28	
May 27	1500	14.0	8.51	1110	0.16	0.22	
June 3	1530	20.3	8.12	1134	0.14		Inlet water level 8 in below culvert
June 17	1500	13.7	7.80	1100			No flows
June 24	1430	15.0	8.42	1090			